Industry Power

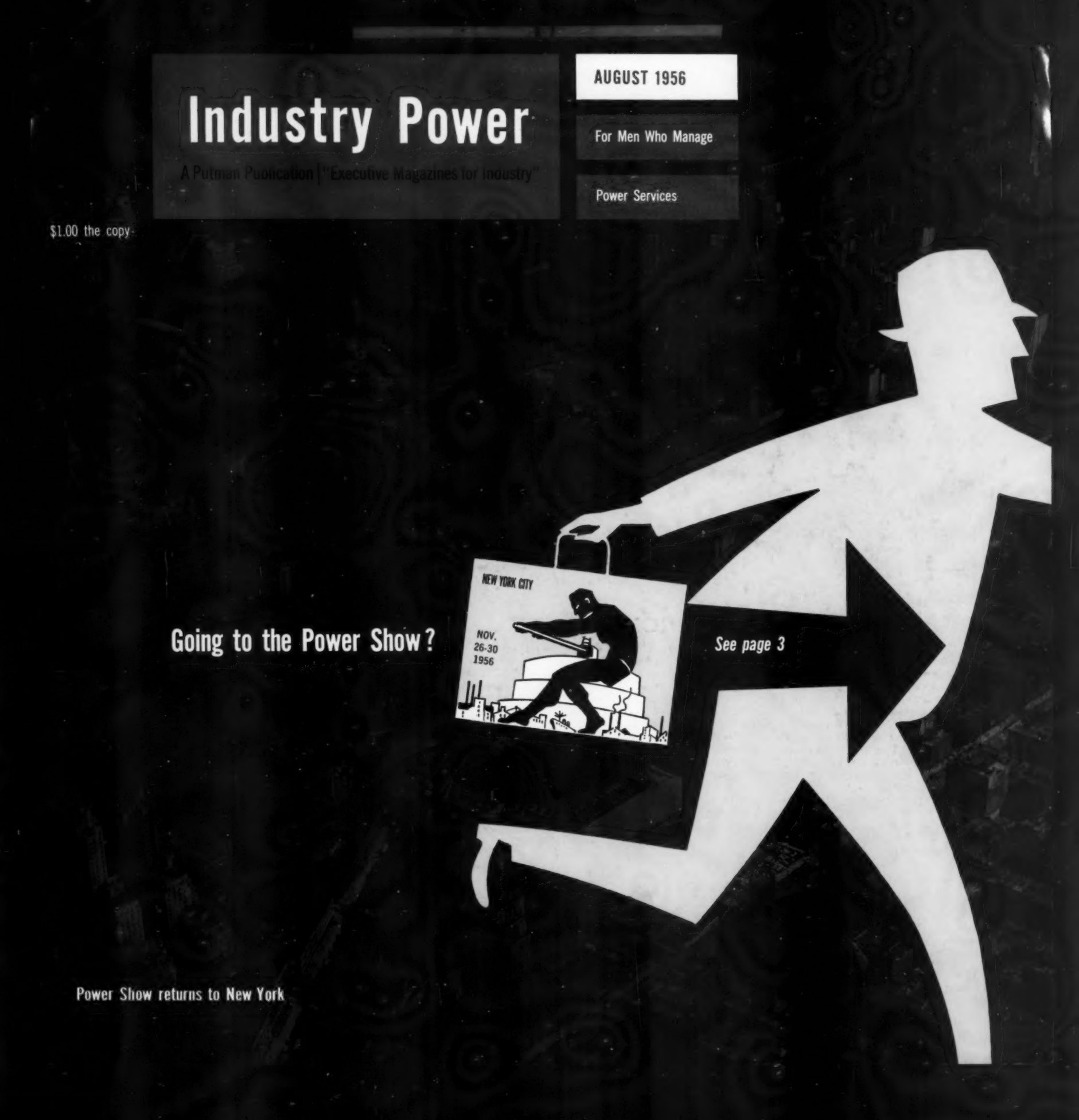
A Putman Publication | "Executive Magazines for Industry"

AUGUST 1956

For Men Who Manage

Power Services

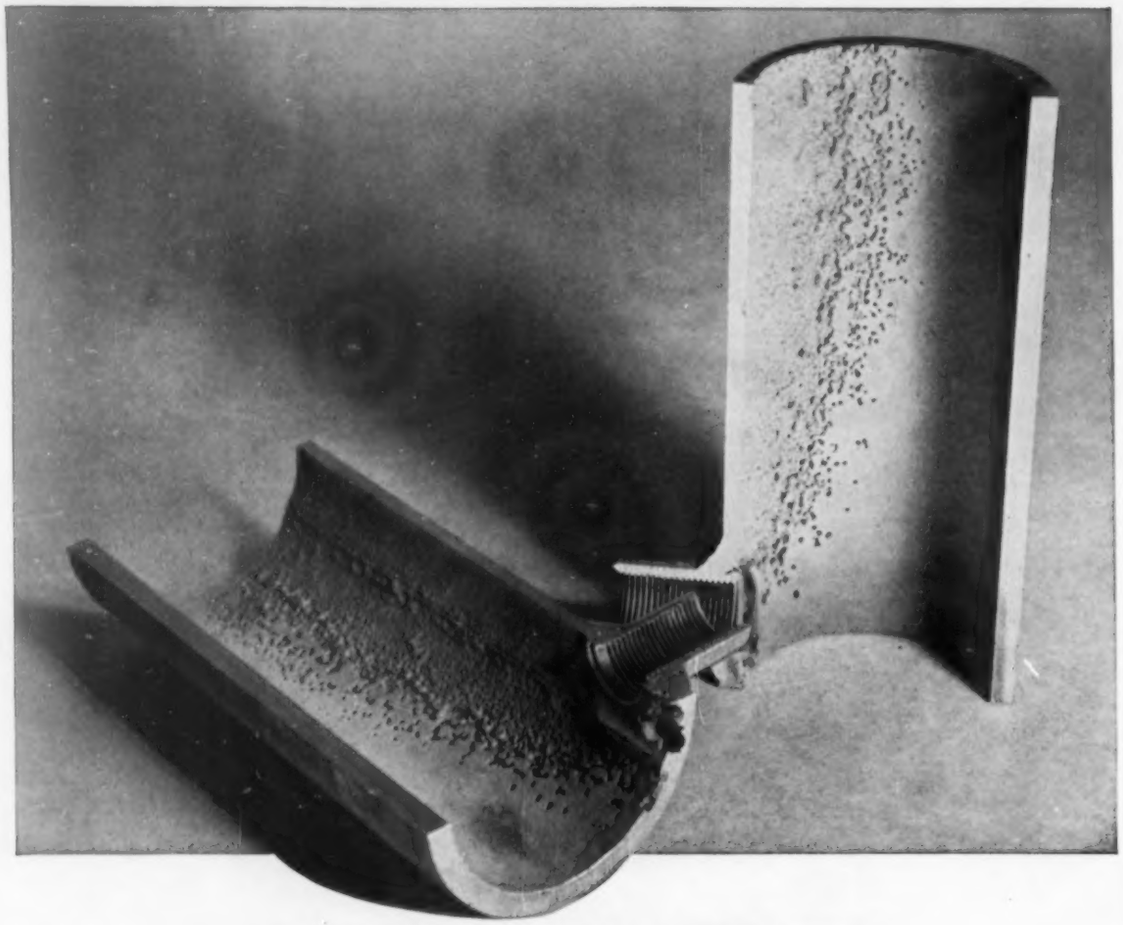
$1.00 the copy



Going to the Power Show?

See page 3

Power Show returns to New York



PIT-POCKED PICKPOCKET

In power-demanding industries, pitted pipe means out-of-pocket expense. The annual losses in labor and materials to replace equipment damaged by cavitation and corrosion reach staggering proportions.

The corrosive attack against this pipe was accelerated by mechanical action. Cold water injected into a high-pressure condensate return line caused steam collapse, resulting in violent hammering and cavitation-erosion damage. Because shock forces disrupted protective films on the interior surface of the pipe, failure occurred rapidly in this short section.

Dearborn Engineers spotted the cavitation problem, and recommended design changes which eliminated the trouble. Thereafter the entire return line system was fully protected by Filmeen.*

Dearborn Filmeen, a concentrated amine treatment, forms a continuous corrosion-inhibiting barrier between condensate and metal. This non-wettable film protects against both carbonic acid and oxygen corrosion. Filmeen readily disperses in hot condensate, permitting continuous feed direct to boiler or steam system.

Take advantage of Dearborn's Water Treatment and Engineering "know-how." Your Dearborn Representative will demonstrate Filmeen's efficiency in combatting destructive corrosion. He will survey your system and recommend control measures and feeding arrangements best suited to your plant requirements. The coupon will bring full details.

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wherever it occurs

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Chicago 54, Ill.

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☐ Send me more information on Dearborn Filmeen Water Treatment Service.

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Company.....
Address.....
City.....*Zone*.....*State*.....

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Industry Power

A PUTMAN PUBLICATION

Commercial Bank Building, Saint Joseph, Michigan

VOLUME 71 NO. 3 AUGUST 1956

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Tell us why, in 25 words or less, your company would benefit if you would spend a week at the 1956 Power Show in New York next November 26 to 30. Use the entry blank on this page and . . .

win yourself a free trip to the power show

Enter now! Contest closes September 7, 1956!

Here are the Official INDUSTRY POWER Power Show Contest Rules. . . .

1) All entries must be submitted on official entry blank clipped from this page. Tell why, in 25 words or less, you think your company would profit by you attending the 1956 Power Show. All information requested on the entry blank must be filled in legibly.

2) Send entries to: Contest Editor, INDUSTRY POWER magazine, Commercial Bank Building, St. Joseph, Michigan. Entries must be postmarked no later than September 7, 1956, and must be received by the Contest Editor no later than September 14, 1956.

3) All readers of INDUSTRY POWER are eligible. Entries will be judged on originality, sincerity, and aptness of thought. In case of ties, duplicate prizes will be awarded.

4) Judges' decisions will be final. Entries become the sole property of INDUSTRY POWER. None will be returned. Winners will be announced in the November, 1956 issue of INDUSTRY POWER.

First Prize: First-class round-trip transportation expenses to New York, five days at the Hotel Statler in New York City during the week of the ASME 1956 Annual Meeting and POWER SHOW, tickets to ASME Annual Meeting events, all meals, plus $100 expense cash.

Second Prize: Five days at the Hotel Statler in New York City during the ASME 1956 Annual Meeting and POWER SHOW, tickets to ASME Annual Meeting events, and all meals.

To: Contest Editor, INDUSTRY POWER
Commercial Bank Building, St. Joseph, Mich.

Name_____ **Title**_____

Company_____

Street Address_____

City_____ **State**_____

This is why my company would profit by sending me to the Power Show (use 25 words or less):

_____

_____

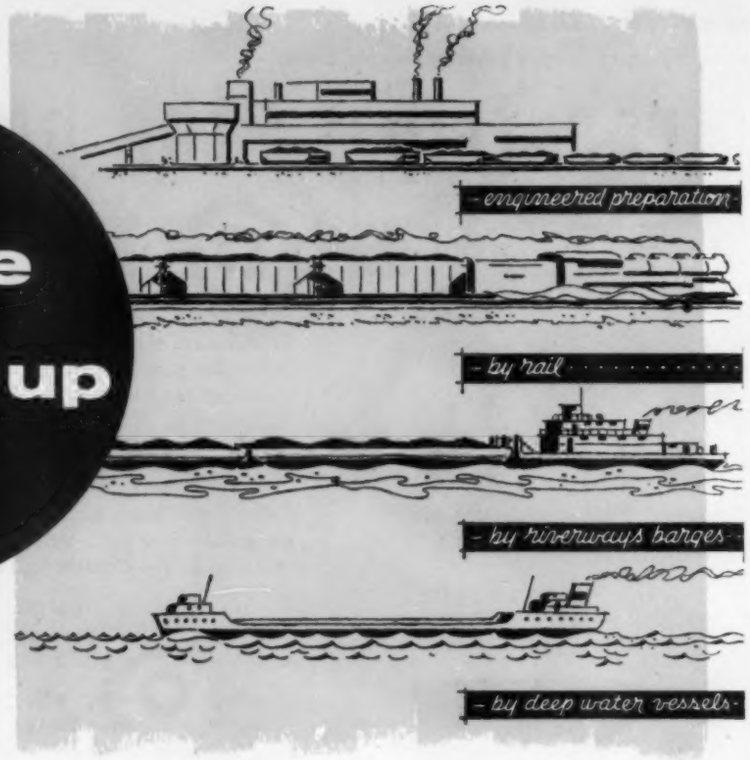
_____

_____

_____

_____

Date_____ **Signature**_____



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From its low cost recovery to its delivery at your stock pile, every step in the preparation and handling of Southern's coal is controlled to the specifications established for widely varied industrial applications. It's washed, dried and accurately sized. It's freed of excess moisture, ash, sulphur and dust—quality controls that are continuously resulting in higher combustion efficiency and lower operating and maintenance costs in all types of industrial and public power plants . . .

* You can get any quantity of these superior coals, engineered to your specifications, shipped to your plant anywhere in Mid-America by rail, by river barges or through the Great Lakes at favorable rates.

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23 million tons annually from 27 modern mines in Eastern and Western Kentucky; Indiana; northern, central and southern Illinois; Ohio; Alabama; Iowa; Missouri and Oklahoma.

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SINCLAIR COAL COMPANY, KANSAS CITY 5, MO., WESTERN REPRESENTATIVE

Circle 111 on READ-N-CIRCLE card for more data

late news

. . . about industry power

• Cathodic protection in sea water

Examination of data obtained by Naval Research Laboratory and others shows that the best available criterion for the cathodic protection of steel in sea water is polarization to -0.85 volts to a copper-copper sulfate electrode. There is evidence that this is inadequate in heavily polluted and certain other waters. A review of research indicates that the major forces influencing current distribution in cathodic protection are water resistivity and polarization. Relatively high water resistivity tends to give nonuniform current distribution, high polarization gives uniform distribution.

• Unit heater code available

An American Society of Heating and Air-Conditioning Engineers code for testing and rating direct-fired unit heaters and heavy duty furnaces has been published. It is applicable to units with output ratings in excess of 250,000 Btu/hr. ASHAE code for testing and rating heavy duty furnaces and direct-fired unit heaters contains eight sections covering purpose, scope, definitions, rating limits, testing equipment, testing procedures, and rating procedures.

• Extend steam tables to 10,000 psia

New steam tables covering the range from 5500 to 10,000 psia and from 32 to 1600 F are now available for power systems calculations. Tables are not based on new data, but are reasonable and consistent extensions of the Keenan and Keyes tables. New data were prepared by a subcommittee appointed by the Power Division of ASME. Subcommittee used presently available tables and, in regions not previously evaluated, developed a table using graphical and numerical methods. New data, plus a table developed by United Aircraft Corporation, were joined to the Keenan and Keyes steam tables to provide data over a broader range of pressures and temperatures. New tables are expected to meet the needs of industry until ASME completes the studies and experimentation for a more authoritative steam table to 15,000 psia and 1500 F.

• Reactor control contract awarded

Contract to engineer and supply the complete control system for the ETR (Engineering Test Reactor), to be located at the National Reactor Test Station, Idaho Falls, has been awarded to Leeds & Northrup Company. Award was made by Kaiser Engineers, prime contractor for the reactor's design and construction.

• Utility uses microwaves

Cleveland Electric Illuminating Company has installed a Motorola microwave link between two of its substations to provide protective relaying, as well as telemetering and voice communications. This is the first installation to use Motorola microwave, multiplexing, and wide-band carrier for the transfer of trip signals from one substation to another. Installation has saved

(more late news on page 8)

A PUTMAN PUBLICATION

Industry Power

For men who manage power services

VOLUME 71 NO. 3 AUGUST 1956

In this issue . . .

compressed air ready for tomorrow 12
Here's how Caterpillar Tractor Co. planned for added compressed air demand from either increased production or plant expansion. Engineered air system provides for all contingencies.

stationary batteries give dependable power 14
Find out how Pennsylvania Power & Light, the City of Cleveland, and Pittsburgh Steel all get dependable power for emergency facilities. Maintenance is vital in keeping batteries ready.

play it safe — fire either coal or oil 16
Paper Manufacturers are ready for any change in fuel supply. They can change from oil burner to stoker without structural modifications. See how fuel economics influenced this design.

is your motor control just half safe? 18
Read how inadequate short-circuit protection in motor control can cause serious injury and property damage. Be sure your motor control can handle everything your system can feed it.

emergency pumps save $22,905 20
Learn how emergency pumps, installed to save power station, increased operating efficiency.

power basics for today's industry
I—vapor compression refrigeration 21

unit heater maintenance 29
Review time-proven checklist to get tips on how proper maintenance will put your heating units in top shape. Get all the built-in capacity for trouble-free operation this coming winter.

in brief — Purdue industrial waste conference 32
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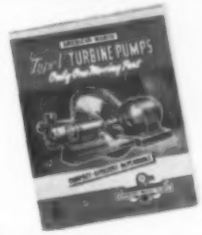
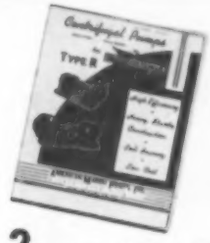
Seven helps for you
in solving innumerable
pumping problems



1. *Bulletin 450*—Describes Type V Turbine Pumps for handling non-viscous, non-abrasive fluids.



2. *Bulletin 300*—Type R Single-stage, End Suction Centrifugal Pumps described.

3. *Bulletin 381*—Covers Type HHM Centrifugal models for boiler feed. Large section view.

4. *Bulletin 202*—Duplex Steam Driven Piston Pumps. For general and boiler feed uses.

5. *Bulletin 280*—Simplex Steam Piston, Plunger Pumps for handling heavy, viscous liquids.

6. *Bulletin 460*—Covers Type OSO Centrifugal Process Pumps for hot oil, corrosive fluids.

7. This, of course, is the helpful cooperation and "know-how" your nearby American-Marsh Representative offers. Trained and experienced, he's ready to assist you in selecting the *most economical, satisfactory* pump for your application. Call him soon!

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"Pumps and Pumps Only Since 1873"

In Canada: American-Marsh Pumps (Canada) Ltd., Stratford, Ont.

Gentlemen: Send me bulletins checked:

Bul. 450 Bul. 300 Bul. 381 Bul. 202 Bul. 280 Bul. 460

Name
Title
Company
Street
City Zone State

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Why be half safe?

Specify AUTO-SPEED interruption . . . 3E Air Interrupter Switches

Howard Shatzer, 3E field engineer, checking an Air Interrupter Switch before shipment.

What is **Auto-speed interruption** . . . an automatically produced interruption that always occurs at the same point in the switching operation, and always takes the same time (one-half cycle). Human error is eliminated from the switching action by a trigger spring mechanism which trips the switch at a pre-set point. Contacts are separated inside a dry type interrupter unit.

Specify safety for personnel and equipment No exposed Arc. 3E Air Interrupter Switches will not produce external arcing dangerous to men or equipment.

Specify economy Costing less than circuit breakers and with interrupting capacity not found in air break disconnects, 3E Air Interrupters are ideal for . . . interrupting magnetizing charging current of transformers . . . interrupting charging current of lines and busses . . . interrupting exciting current of feeder regulators . . . interrupting load currents to rated capacity . . . sectionalizing feeders and distribution circuits.

Specify Engineering Ability 3E's staff of engineers is experienced in adapting or combining equipment for complete switching centers or additions to existing units. Designing for unusual needs . . . corrosive or dusty atmospheres, unique space requirements, portable units, or carefully calculating tomorrow's expansion requirements . . . we are geared to handle the unusual.

Howard Noble, 3E Sales Promotion Mgr., demonstrates Air Interrupters in a complete cubicle installation.

3E Air Interrupter Switches are made in ratings up to 15 K.V.

Write for Bulletin 152

ELECTRICAL ENGINEERS EQUIPMENT CO. Melrose Park, Illinois

Representatives in principal cities—in Canada by Power-Lite Devices, Ltd.

Circle 138 on READ-N-CIRCLE card for more data

nuclear news

. . . about industry power

SUMMARIZE PRESENT PROJECTS

Status of the AEC Reactor Demonstration Program was summarized recently as follows: No concepts have reached the commercial phase as yet. One prototype reactor (the pressurized water reactor at Shippingport, Pa.) is actually under construction. Firm plans have been developed for five large-scale and two small-scale prototype reactors. These planned reactors should be completed by 1960 or 1961 under present timetables.

PUSH INDUSTRIAL-SIZE REACTORS

"Special consideration" of reactors in the 10,000-to 20,-000-kw range was urged by the Joint Congressional Committee on Atomic Energy reporting out a $400 million bill for an accelerated civilian atomic power program. The Committee directs the AEC to "develop reactor designs which show promise of significant advances in reactor technology and to construct under private contract as soon as practicable smaller prototype power reactors which utilize such advanced concepts" for small-scale power reactors.

EMERGENCY POWER PLANT TO KIDDE

Design of a one-cycle emergency nuclear power plant will be produced for the AEC by Walter Kidde Nuclear Laboratories. Design is expected in seven months.

INSTRUMENT MAKERS' COUNCIL

Nuclear energy has become a business large enough to warrant a Nuclear Instrumentation Manufacturers' Council under the wing of the Atomic Industrial Forum. Among activities planned for the Council are studies on government activities, development of a directory to serve as a single reference source to the industry, and compilation of industry statistics.

AEC WINS SAFETY AWARD

An award of honor has been given to the AEC in recognition of the 1955 safety record of the commission and its contractors by the National Safety Council.

During last year, frequency rate of all accidental injuries in the atomic energy program decreased 29 percent below the average of the previous three years. Injuries in 1955 were 40 percent less severe than the 1952-54 average.

BACK TO SCHOOL

Education for atomic energy is taking many forms these days. A lecture-discussion-demonstration course is being sponsored in atomic energy next October by the National Industrial Conference Board . . . . Sixty engineering professors from 36 American engineering colleges assembled this summer at Argonne National Laboratory's Nuclear Energy Institute to pick up material on nuclear engineering for incorporation into their courses of instruction . . . . Thirty men from 22 engineering colleges will attend a second Institute on Nuclear Engineering — this one being held at Brookhaven National Laboratory to accommodate the overflow from the Argonne sessions . . . . Three training courses for high

school science teachers are being offered at University of New Mexico, Harvard University, and Duke University. Scientific demonstration kits will be provided to the teacher-students so that they can demonstrate the techniques they learn this summer.

ENTHUSIASM, THEN PESSIMISM

Following an era of almost-unbridled enthusiasm, word from the AEC paints a rather dim picture for the future of atomic power. In summary, it is now said that "the prospect of getting industrial atomic power in the near future is very gloomy. The government has prematurely abdicted [sic] to private industry the primary responsibility for building large power reactors. Important reactor types have been staked out by individual companies or groups. Yet there is no firm assurance that these and other power reactors will be built in the near future." It is then urged that the "government assume the primary responsibility for large reactor construction."

COAL NOT REALLY THREATENED

By 1970 or 1975, the rate of bituminous coal mining will double the present rate, according to an AEC statement before the National Coal Association's 39th Anniversary Convention. During the next 15 to 20 years, nuclear power seems likely to have significant effects on coal demands only in the field of electric power generation, according to W. Kenneth Davis, AEC director of reactor development. He told the National Coal Association that the largest effect here is that coal demands may grow only at the same or at a slightly greater rate than the demands for other fuels instead of at a much greater rate.

NEW JONES & LAUGHLIN WATER-TREATMENT PLANT *with* AUTOMATION *and* EQUIPMENT *by* INFILCO

cuts hardness from 268 to 2 p.p.m. –greatly reduces labor costs

The Monongahela River is the source of raw water for steam generating plants of Jones & Laughlin Steel Corporation. Total hardness ranges up to 268 p.p.m.—clarity and degree of acidity fluctuate widely.

Using a cold-process, lime-batch plant, hardness could only be reduced to about 1.5 grains per gallon, or 26 parts per million.

INFILCO equipment, including C.-A.-P. SYSTEM® instruments was chosen for greater efficiency and automatic operation. The new plant produces water averaging about 0.1 grain per gallon —2 p.p.m.—hardness. It has cut labor costs more than 50% and made better service possible. And the end result — steam production — is more efficient and economical, too.

This is another example of INFILCO leadership in this field — further proof that

Infilco knows how

to help you solve your water-treatment problems. For complete information about this interesting installation, write today for Reprint No. 70 IP-11.

INFILCO INC.

General offices, Tucson, Arizona

*The **one** company offering equipment for **all** types of water and waste treatment*

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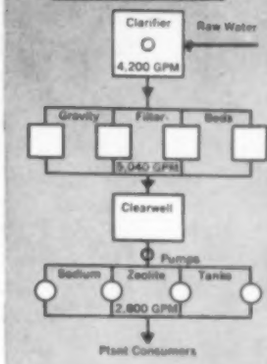
INFILCO EQUIPMENT automatically

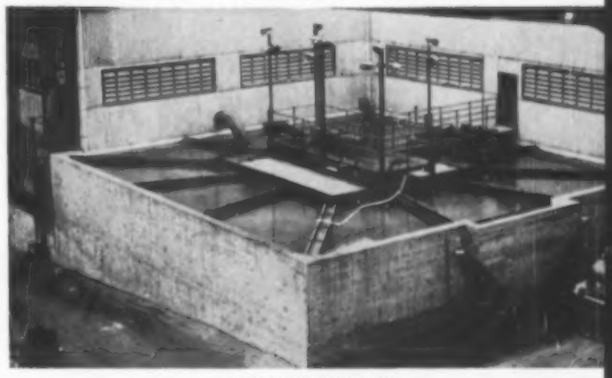


...MEASURES flow, maintains constant water level, keeps amounts of chemical proportional, removes sludge.

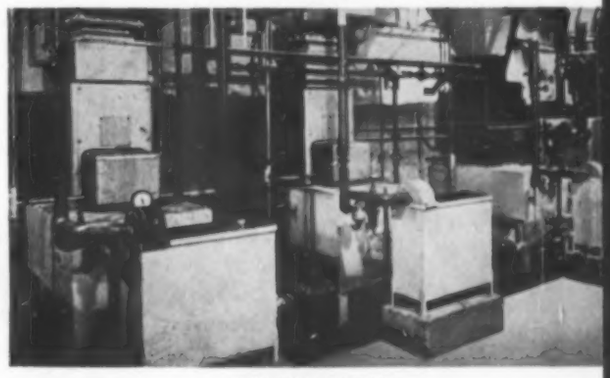
...EQUALIZES water passage by flow control and loss-of-head control, maintains same flow rate, controls backwash.

...PUMPS water to softening units and then meters it to five 175,000-lb./hr. boilers for steam generation.

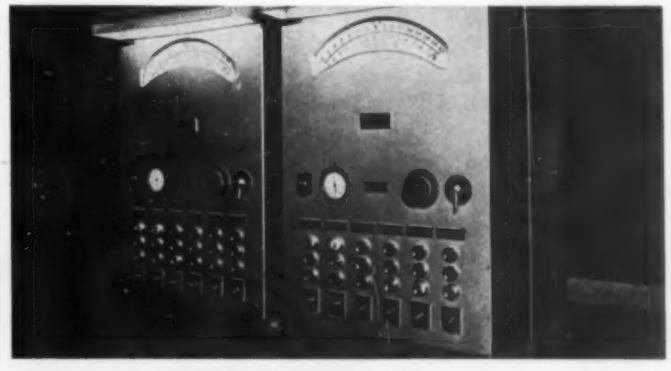
MAIN PLANT COMPONENTS AND AUTOMATION



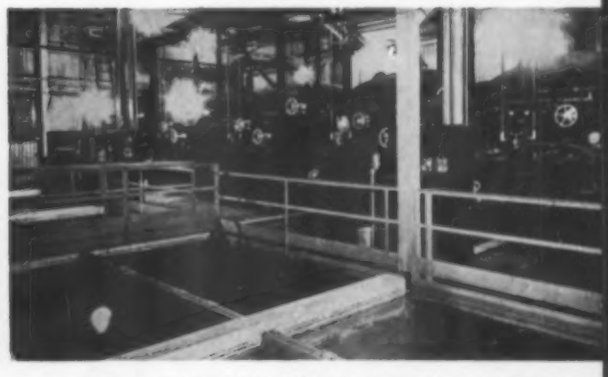
CLARIFICATION BASIN



CHEMICAL FEEDERS



FILTER BED CONTROL PANELS



ELECTRICALLY CONTROLLED SODIUM-ZEOLITE SOFTENING UNITS

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Your plant and equipment suffers . . . your community goodwill fades away. These problems can be solved. Prat-Daniel Collectors are designed for the control of industrial dusts and flyash. Multiple small diameter tubes provide powerful centrifugal forces, resulting in sustained high collection efficiency . . . even with ultra-fine dusts.

Whether the problem is industrial dust or flyash, you are assured of satisfaction with P-D Collector Systems, engineered to meet your specific needs.

Write for Reprint No. 102 titled, "What Type Collector?"

pd

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POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

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late news

. . . starts on page 4

the utility capital equipment and installation costs of a 132-kv circuit breaker. Protective relaying system provides protection for both the transmission line between the two substations and a 100,000-kva, 66/132-kv autotransformer. Line protection is provided for phase-to-phase and ground faults; transformer protection is provided for overcurrent, loss of oil pressure, and internal ground. Impedance and ground relays control the trip signals sent over the wide-band carrier and microwave. Tests have shown 99.984 percent reliability and 100 percent security. Time for the transfer of the trip signals is 10 milliseconds.

• New college of engineering

Michigan State University plans to build a new College of Engineering on its south campus. Project will be developed over the next five years at an approximate cost of $13 million. Inside the Department of Applied Mechanics laboratories it is hoped to install an ultra-modern machine for testing new engineering designs. The Mechanical Engineering laboratory will house several test cells for experimental work with jet engines, and fundamental studies in heat flow and combustion of fuels.

• New hydro in the East

Appalachian Electric Power Company is starting necessary steps to build a hydroelectric power plant of at least 60,000-kw capacity on the Roanoke River at Smith Mountain in Virginia. (Appalachian is a subsidiary operating company of American Gas and Electric Company.) These steps include immediate application to the Federal Power Commission for a preliminary permit, completion of explorations of the damsite, and arrangements for disposition of roads affected by the reservoir. Cost of project is estimated at $20 million.

• Blaw-Knox integrates operations

Blaw-Knox Company, Pittsburgh, has announced a major integration of its manufacturing operations and the appointment of two vice presidents to manage the new groups.

Components of the newly formed operating groups will be:

Foundry and Mill Machinery Operations: Continental plants, Lewis Machinery plant, National Alloy plant, Rolls plant, and Union Steel Castings plant.

Fabricated Products Operations: Blaw-Knox Equipment plant, Buflovak Equipment, Construction Equipment, Copes-Vulcan, Dairy Equipment, and auxiliary facilities.

• Machine to translate languages

There appear to be no insurmountable engineering problems in the realization of a mechanical translating machine, according to R. E. Wall, Jr., of the University of Washington, Seattle, Washington. He continued, "It seems likely that such a machine will cost as much as a modern large-size digital computer which has a per-hour cost of about $250. Human translators will produce rough, understandable translations for a per-word cost of about one cent. This means that a $250/hr machine would have to produce about 25,000 words per hour, or in round numbers, about 10 words per second, in order to have the same per-word cost."

• What is air conditioning?

To clarify confusion that exists over the meaning of "air conditioning," a simplified definition has been prepared and adopted by the Amercan Society of Heating and Air-Conditioning Engineers. Definition announced by Society President John W. James at the recent Semiannual Meeting in Washington, D. C. reads: "Air conditioning is the process of treating air so as to control its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space." ♦ ♦

It's so easy to enter the Power Show Contest

Just think how your company would profit by your attending the 1956 Power Show, fill out the entry blank on page 3, and drop it in the mail. You may win!

• *Submitted by reader M. E. GRADY, Buick Motor Division, General Motors Corporation.*

our readers write

. . . to industry power

How big is small?

Gentlemen:

I wish to compliment you on the "up-to-dateness' and diversity of material in your magazine and the fact that you do not forget to take the small plant into consideration.

J. Walker
Detroit, Michigan

● *Thank you for the kind words. We do aim to give editorial coverage corresponding to the "profile" of our readership. One problem is to define how "big" a "small" plant has to be before it is a significant user of power services. For an interesting analysis of our readers' plants — which are your plants, of course — turn to page 43 of this issue.*

That condensate meter

Gentlemen:

Please forward name and address of the manufacturer of Cadillac condensate meter to which you referred in your May issue of INDUSTRY POWER.

L. L. Safford
Chief Engineer
Plastics and Resins Division
American Cyanamid Company
Wallingford, Conn.

● *Cadillac condensate meters are manufactured by Central Station Steam Company, 2915 E. Woodbridge Ave., Detroit, Mich.*

Please bear with us

Gentlemen:

We wrote to you a week ago relative to correspondence indicating that a set of Electrical Refresher series would be available after the publication of your July issue.

Since writing you, we have heard nothing further from you in this connection and we are again calling the matter to your attention. Would you please advise us immediately when this series referred to above will be sent to us.

M. N. Holmes
North & Judd Manufacturing Co.
New Britain, Conn.

● *More than 1000 requests have been received already asking for reprints of the Electrical Refresher in INDUSTRY POWER's Power Basics series. This reprint will be available early in August. We are gratified to find our original estimates fell so far short of actual demand.*

In water conditioning... there's one way to be sure!

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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Research Laboratory, The Mead Corporation, Chillicothe, Ohio. Lorenz & Williams, architects, Dayton; Schweiger Heapy & Asscoiatea, mechanical engineers, Dayton.

Control Flexibility-

● It's a "must" when you have diversified temperature and humidity requirements

Strategically located Johnson Thermostats operate Valves and Dampers on six large heating and ventilating units serving the spacious pilot plant laboratory.

Stress and strain breaking points of Mead carton stock are tested in a constant temperature and humidity room. Perfectly conditioned air is supplied by a built-up air conditioning unit under the highly accurate control of a Johnson Recorder-Controller.

Printing research is among other activities conducted under carefully controlled temperature and humidity conditions. Sensitive Johnson Room Thermostats, controlling mixing dampers on a central double duct air conditioning system, produce the exact conditions required.

The extensive research and development program of The Mead Corporation, one of the nation's leading papermakers, offers an interesting example of the varied temperature and humidity control needs of today's industrial buildings. At Mead, these include:

- Control of a central double duct air conditioning system serving laboratories, offices, library and public areas.
- Control of a separate air conditioning unit for a constant temperature and humidity laboratory (temperature, 75°F; rel. humidity, 50 per cent).
- Control of a variable temperature and humidity test room to maintain any temperature from 50° to 100°F and any relative humidity from 20 to 80 per cent.
- Control of combination heating and ventilating units for a pilot plant laboratory.
- Weather-compensated control of the hot water baseboard radiation system.

A Johnson-engineered Pneumatic Control System easily provides the necessary flexibility to satisfy each one of these requirements . . . *and with a precision that insures virtually waste-free heating, cooling and ventilating operation!*

This system, like the Johnson Systems in countless other industrial buildings, was designed and installed to meet the exact needs of the individual building. Regardless of how complex or diversified your control problems may be, you can count on this traditional Johnson policy to provide your plant with an equally successful, flexible control system.

Next time you have a temperature, humidity or process control problem, talk to an engineer from the specialist Johnson organization. His recommendations are yours without obligation. Johnson Service Company, Milwaukee 1, Wisc. Direct Branch Offices in Principal Cities.

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SINCE 1885

PLANNING • MANUFACTURING • INSTALLING

Circle 116 on READ-N-CIRCLE card for more data

Industry Power

Commercial Bank Building, Saint Joseph, Michigan

VOLUME 71 NO. 3 AUGUST 1958

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BPA NBP

Four indexes for your convenience

- Major articles are indexed on title page. See page 5.
- Advertisers are indexed alphabetically. See page 57.
- Advertisements are indexed by products in handy guide. See page 51.
- Important literature is indexed by products. See page 45.

this month's comment . . . .

Why a Power Show Contest?

Because we want *you to tell us* why the Power Show is important to you and your company.

You are the best judge of how and why the Show is valuable. Your opinion will guide readers who have never been to a Power Show, will help them plan their trip to best advantage.

And, your opinion will also help the manufacturers who display their equipment at exhibit booths.

INDUSTRY POWER's job is to help you do a better job—for your own benefit and for that of your company.

We believe that by attending the Power Show you will be able more fully to do that better job. But we don't know that our readers really think so unless you tell us!

At the Show you not only see new equipment and improvements on standard products, but also you get to ask questions of the *factory men* at the booths of the equipment manufacturers.

Does your company management know these benefits? And, the time-saving from your being able to inspect so much equipment in so short a time?

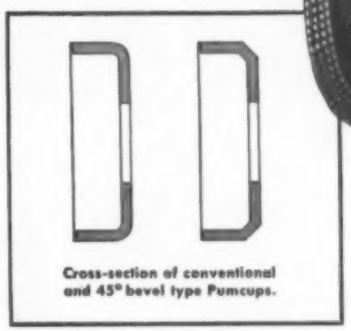
We hope you'll tell us your reasons — that's why a Power Show Contest.

Check back to page 3—all the details about entering the contest are there.

John Paul Taylor

John Paul Taylor
Editor and Publisher

2-way gain with PUMCUPS



Cross-section of conventional and 45° bevel type Pumcups.

Darcova Pumcups are available in various types and textures, in a complete range of sizes, to provide unequalled efficiency and long life in reciprocating pumps, air or hydraulic mechanisms.

★ prolonged high efficiency
★ less maintenance

TODAY hundreds of companies using hydraulic controls, air cylinders or reciprocating pumps are *standardizing* on Darcova Pumcups for piston packing, because they eliminate fluid slippage, costly down-time and maintenance.

Darcova Pumcups make the *most* of the cup packing principle. And, they are made in a complete range of sizes, types and texture-engineered compositions for various pressure-temperature-fluid conditions. Pumcups hold peak efficiency for the life of the cups and outlast other packing as much as 3 to 1.

Why not check these claims right in your own plant? Meanwhile get *all* the facts. Just send for Pumcup Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.
Williamsport 9, Pa.

DARCOVA THE ORIGINAL COMPOSITION CUP
TRADE MARK PUMCUPS

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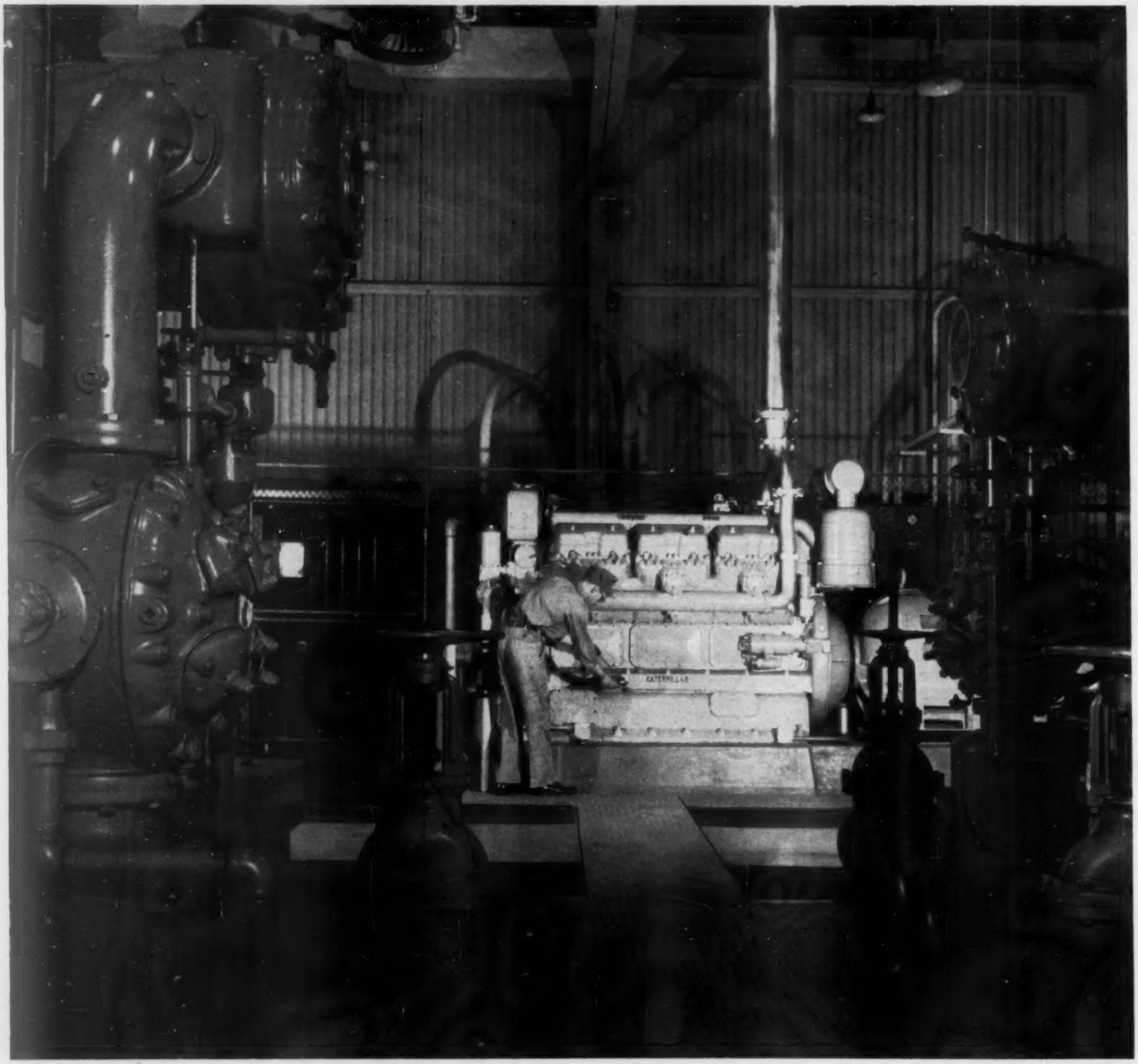

CATERPILLAR

Caterpillar Tractor Co.'s new multimillion dollar Decatur plant provides for all present needs plus room for expansion with . . . .

Compressed air ready for tomorrow

C. R. GALBREATH
Decatur Plant Engineer
Caterpillar Tractor Co.

with R. W. De Moss
Assistant Editor

COMPRESSED AIR supply system to meet the heavy demands of present-day production methods is installed in Caterpillar Tractor Co.'s new Decatur plant, Decatur, Illinois. Air is supplied to over 320 individual air hoists, and 810 air-driven grinders, wrenches, power cylinders, and other air-driven production tools.

Caterpillar, like other heavy-equipment manufacturers, is in the position of having most assembly line components in the "above 50-lb weight class." To conform to present-day practices, therefore, power-lifting and positioning equipment is used extensively throughout the plant.

prefer air-powered hoists

Air-powered hoists, in preference to electric-powered, are used in many cases because of the better speed control and better positioning accuracy possible with air-driven equipment.

Preliminary study of alternate compressor types indicated that considerable savings in floor space and in machine foundation size could be effected by installing relatively high speed "Y"-type compressors as compared to conventional slow-speed, horizontal-type machines.

On this basis, provision was made, in the initial installation, for one twin compressor consisting of one 1600-cfm unit mounted on each end of a 600-hp synchronous electric motor. The second compressor consists of a single 1600-cfm machine similarly connected to a second 600-hp synchronous motor.

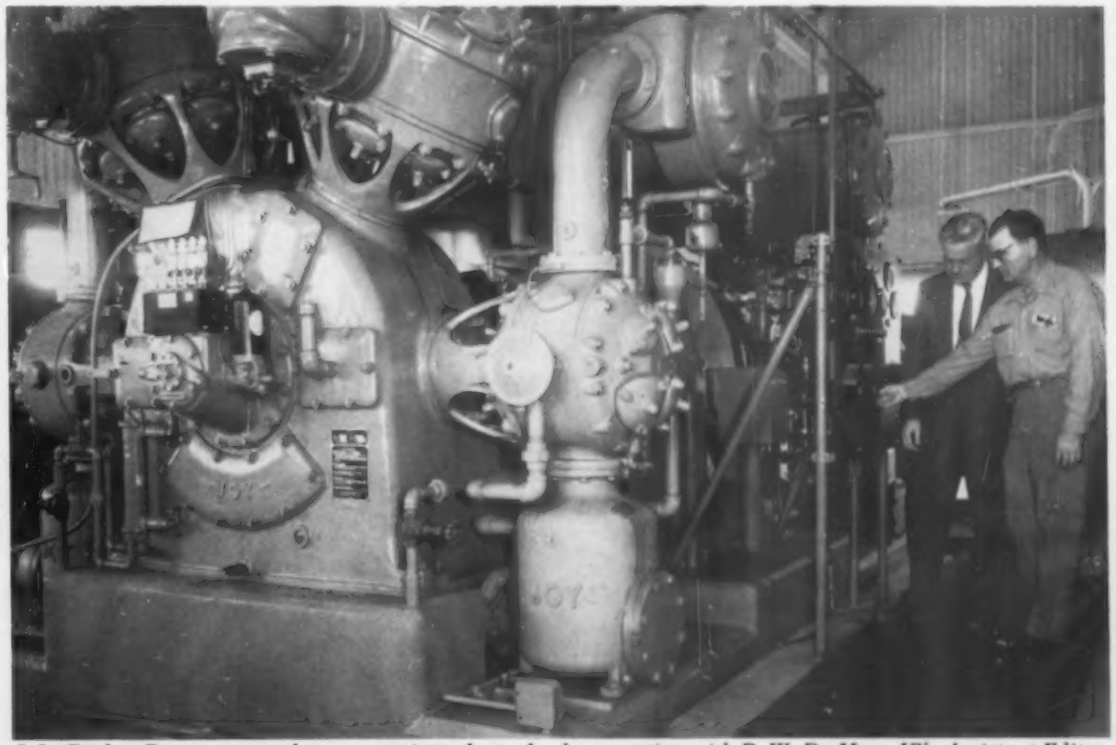
Foundations are in place to receive a fourth 1600-cfm compressor unit on the extended shaft of the second 600-hp motor at such time as an increase in compressed air demand may require it. Provision of this additional unit will add another 33 percent.

Compressors selected were one Joy Manufacturing Co. Class WN-114 twin, two-stage, double-acting compressor, and one Class WN-114 single unit. The twin unit carries a nominal rating of 3200 cfm and is direct-connected through Federal Fawick Airflex No. 16CF500 couplings to a double ended Westinghouse Type GF, 600-hp, 600-rpm, 4160-volt, 3-phase 60-cycle dripproof synchronous motors.

Each twin unit is provided with Joy Class P-12 vertical pipeline type after-coolers and a 54-inch diameter by 14-foot ASME code welded receiver. American Air Filter Co. "Cycoil" oil bath air cleaners are provided on each compressor intake. The Federal Fawick couplings provide a means of disconnecting either end of the motor from the compressor. Couplings permit rapid disconnection of compressor load. The elapsed time being merely that required for air pressure to bleed off the coupling diaphragm.

Each compressor is equipped with 5-step capacity regulation, automatic cutoff and alarm on high temperature or low oil pressure, with automatic control

(continues on page 28)



Powerhouse view with Caterpillar emergency diesel electric set framed by two Joy radial air compressors. J. L. Crisler, Decatur powerhouse superintendent, checks operation with R. W. De Moss, IP's Assistant Editor.

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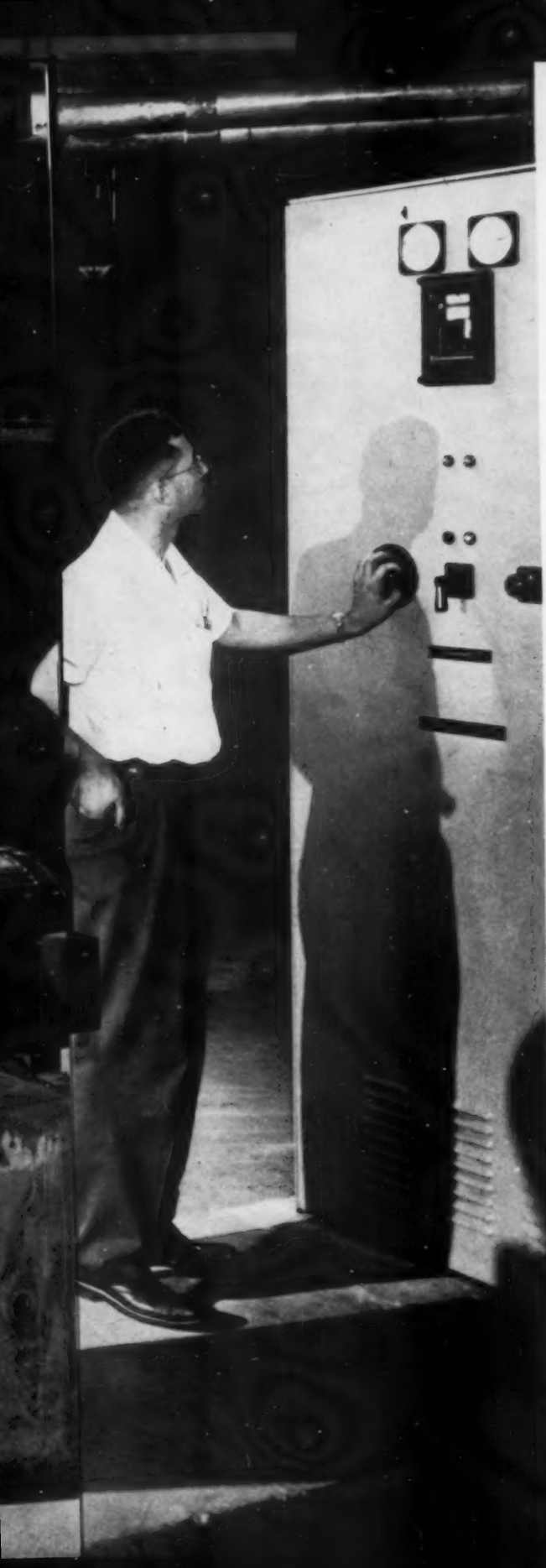


How Pennsylvania P & L, Pittsburgh Steel, and City of Cleveland rely upon storage batteries to . . . .

get DEPENDABLE power for EMERGENCY operations

K. A. VAUGHAN
Manager, Field Engineering
Gould-National Batteries, Inc.

STATIONARY STORAGE BATTERIES provide dependable emergency power to Pennsylvania Power & Light and assure operation of critical control and lighting circuits to supply over half a million consumers. An extensive network of generating stations, transmission and distribution lines, and substations comprise the PP&L system. Hundreds of batteries operate equipment, controls, safety devices, and indicators at these generating stations and substations.

PP&L mounts its battery cells on metal racks painted with protective coating to prevent attack from spilled acid. Metal rails on the rack are covered with rubber insulating strips. Each cell is numbered so that operating records can be maintained. Battery rooms are well ventilated for fume removal, and well lighted so that operators can easily read voltmeters and hydrometers.

Both voltage and specific gravity of each cell is observed monthly. Readings are plotted on a graph Any cell that varies abnormally from the correct voltage or specific gravity is immediately spotted.

Recent installation of a new 120-cell, 800 ampere-hour battery increases flexibility and gives protection against battery failure at Lake Road Generating Station operated by the City of Cleveland. Two stationary 120-cell batteries installed 15 years ago now can be taken out of service for examination and repairs. All three batteries alternate in supplying power to the control circuit, emergency lighting circuit, and power circuit. Two batteries are adequate to supply the power required. One battery is available for standby service, and to permit testing and maintenance of any one of the three.

Batteries provide dc current for three circuits. Emergency lighting circuit illuminates key areas in the event of a failure of normal power. Emergency air compressors are operated by the batteries. Magnetic tramp iron removal equipment, suspended on conveyor belts carrying coal, is powered at all times by battery current.

Battery, plus m-g set, supplies emergency lighting and 13.8 kw switchgear for Pittsburgh Steel.

Control circuit is powered continuously by batteries. Scores of circuit breakers are actuated intermittently by battery power to switch 11,000-volt current to various substations. Many fractional-horsepower control motors are also powered by batteries. For example, the turbine-throttle governor regulating generator speed and output is controlled by a 1/16-hp motor operating intermittently on battery power. Several 1/8-hp motors rated at 0.8 amperes regulate boiler draft openings by changing baffle position over the blower inlet.

In each boiler control panel, a 1/10-hp motor actuates a rheostat controlling current to boiler damper control motors. Steam from the boiler header enters a Bourdon tube. Tube movement is mechanically and electrically amplified. The signal controls motor which changes boiler damper openings to produce steam required by the load.

float batteries give emergency power

Float batteries (as they are often called) are used when the normal power supply fails, and when occasional peak loads are too great to be carried economically by the normal power supply. All batteries are on float charge. Three motor-generator sets can supply the current required to keep batteries at full capacity at all times. All three are diverter pole machines, two with a 15-hp motor connected to a 10-kw generator and one 25-hp motor connected to a 15-kw generator. Batteries will supply current for several hours if power to the m-g sets is interrupted.

Power services engineers can easily check the computations of field engineers to be doubly sure of having control batteries of the proper capacity.

Before selecting a control battery, load require-

(continues on page 30)

Take advantage of fuel price changes
and be prepared for any fuel shortage,
as Paper Manufacturers Company does by planning to

fire either COAL or OIL

DANIEL PARR
Maintenance Supervisor
Paper Manufacturers Company
Philadelphia, Pa.

PRICES CAN change—fuel shortages can occur.

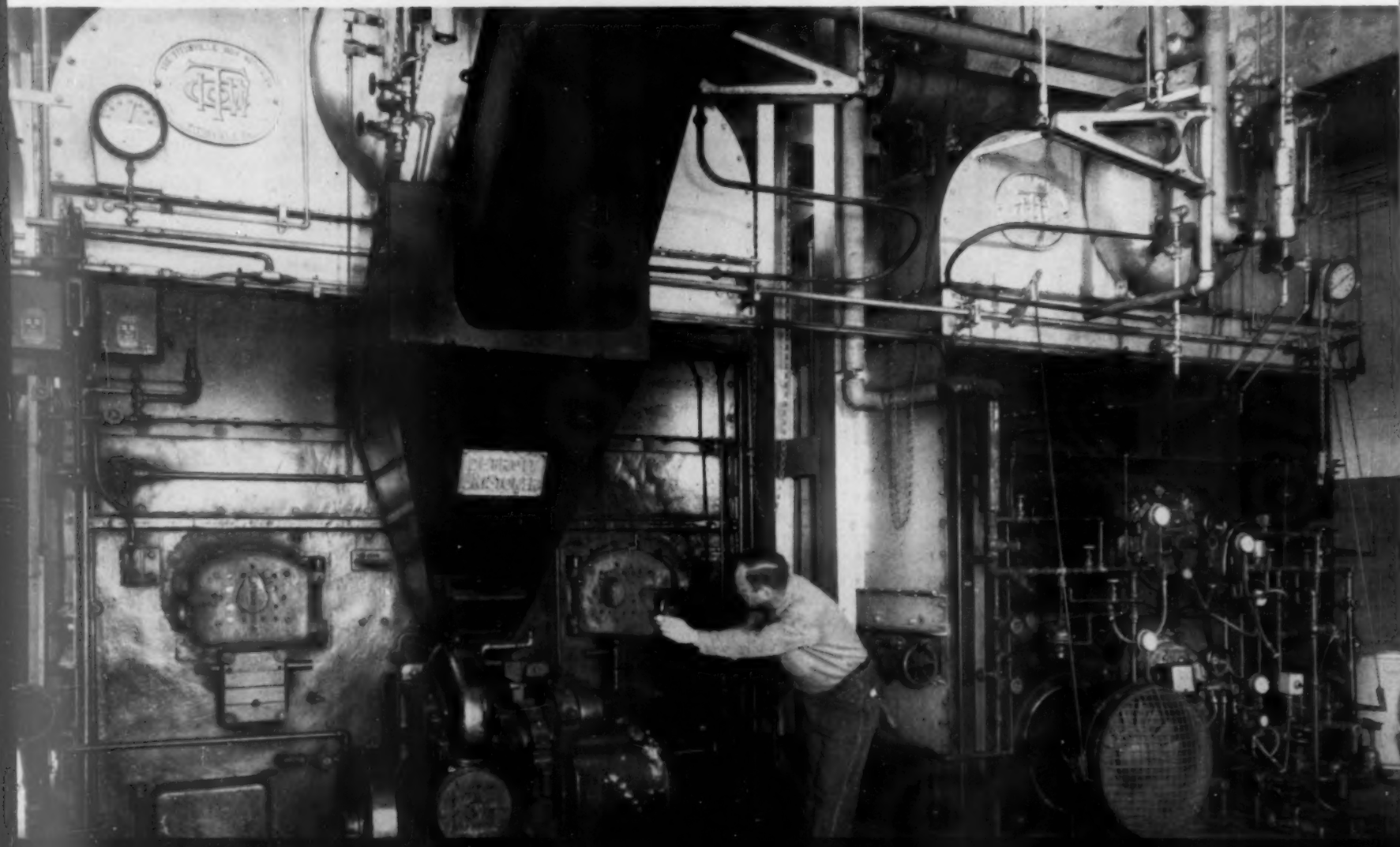
These are the two reasons why we planned our two boilers for firing with either coal or oil.

One of the two Titusville 200 hp, 120 psi boilers is equipped with a Detroit Unistoker for coal firing, the other with Faber oil-firing equipment. Thus, without any changes other than shifting the load from one boiler to the other, we can supply steam for our needs using either fuel.

And, we planned the firing equipment so that

Maintenance Supervisor DANIEL PARR has set himself a strict routine to follow when he walks into his plant in the morning. First a quick check of the boiler room, on to the instruments at the paper dryers, and then a walk through the entire plant and a specific check on the air conditioning. Only then, mind at ease, does he change into working clothes.

In charge of maintenance of all equipment in the plant, he supervises the work of the power engineer, two millwrights, three machinists, and an electrician. He keeps detailed records on equipment at his home plant and the company's Indianapolis plant. All equipment carries identification numbers. Records are kept in large looseleaf books. Each year Parr summarizes equipment maintenance and repair costs to guide him in selecting new and replacement equipment for Paper Manufacturers' plants.



On-the-spot maintenance supervision by author Parr enables him to keep careful track of operating costs.

we can completely and quickly replace the oil burner with a Detroit Unistoker, and thus be entirely coal fired, or vice versa. Each boiler foundation is similar, so a change on either boiler can easily be made by just changing the brickwork. Then, all we need to do is pull out the burners and put in the stoker.

fuel costs the same

We keep careful track of operating costs and find that during the past three years our fuel costs are about the same per lb of steam, whether we are burning Bunker C oil ($0.48/million Btu) or stoker coal ($0.425/million Btu). Of course, oil cost runs higher when we burn No. 2 oil. We do this when the oil-fired boiler is on light load.

Daily steam demand is about 90,000 to 110,000 lb during the winter; from 20,000 to 80,000 lb during the summer. We range from 6.7 to 13.9 lb of steam per lb of fuel (oil or coal), depending primarily on the load. Low load days result in a low fuel rate. Our average is 10.9 lb of steam per lb of fuel.

Coal supplied to us is a blend of Fairmont, Va., (high iron, slags easily) and Ernest, Pa., (coking) coal. The blend is about 50-50, giving us a heating value of between 13,250 to 14,000 Btu per lb, 5 to 6 percent ash.

We moved into this new plant in 1952, during the heating season. Steam was needed to heat the plant before the boilers were erected. To supply this steam, we pulled a locomotive onto the siding alongside the boiler house. For several months this locomotive met our steam requirements—expensive, but it took care of our needs.

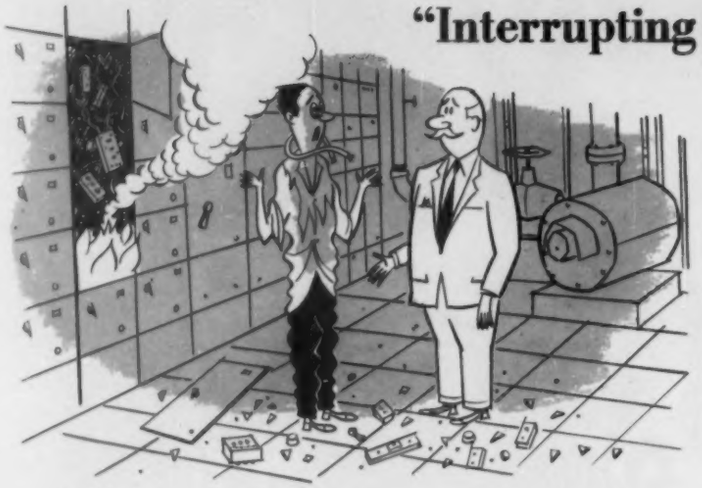
Boilers have a common header from which two steam lines run to the factory (about 5 acres under roof). One line, at 50 psi, is for the heating load; the other, at boiler pressure of 120 psi, goes direct to the dryers used in paper product processing (gummed papers, ticker tape, cash register tape, teletype paper). At the dryers, a modulating valve and pressure recorder enable the operators to regulate dryer steam pressure.

Return lines from the heating system and dryers bring back most of the condensate to the boilers—makeup averages 15 percent. Raw water from the city mains is treated internally according to recommendations of W. B. Coleman & Co., who check the water twice weekly. Polyphase Chemicals Service, Inc. prescribes treatment for fire side of the tubes.

Combustion in the boilers is controlled by an Ace Instruments, Inc. system, based upon measurement of steam pressure in the header and adjustment of fuel feed and airflow to maintain steam pressure constant.

Both boilers are designed so that the firing equipment can be quickly replaced if fuel prices change.

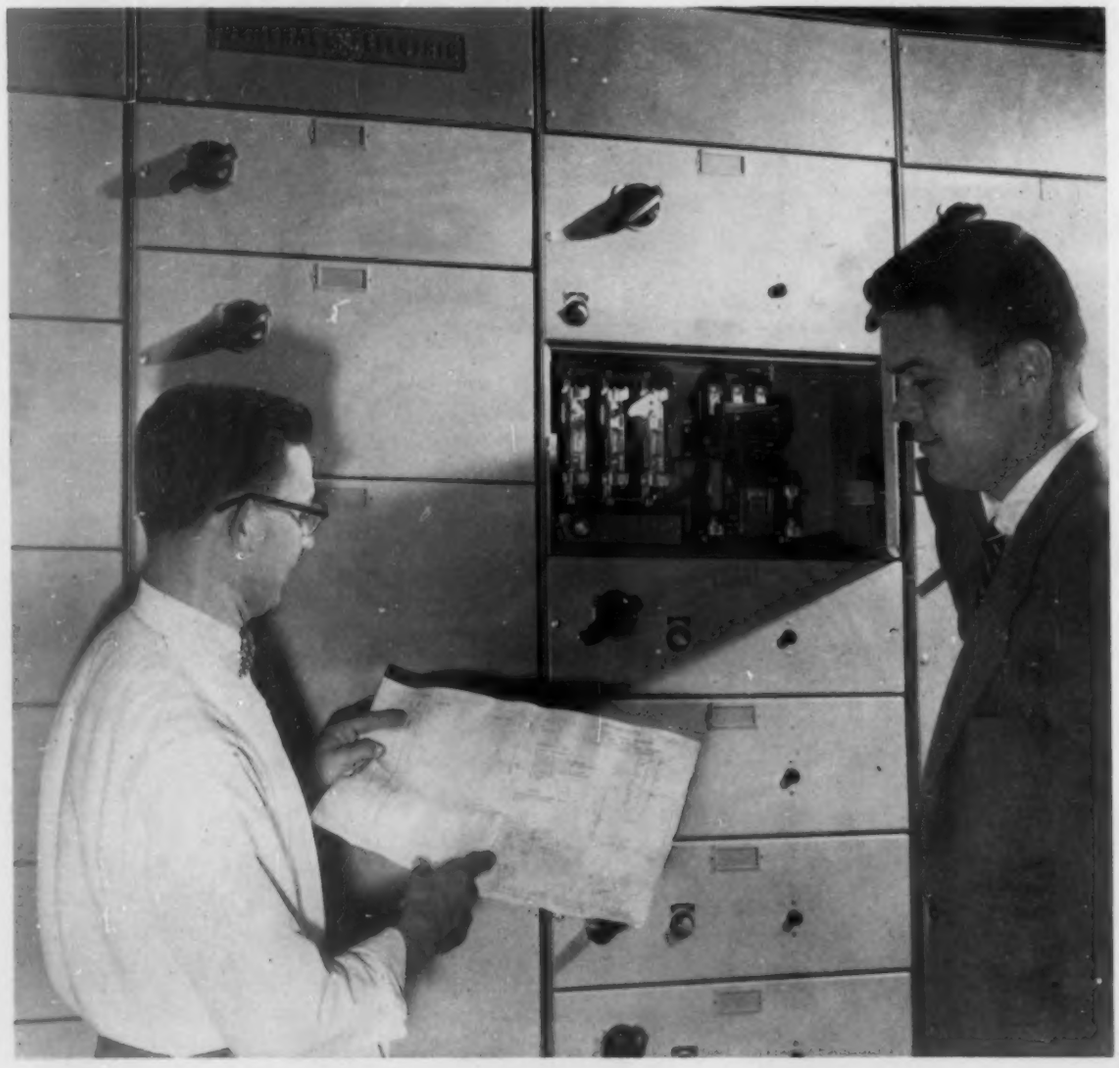
On the boiler panelboard are mounted the Brooke electric eye smoke indicator, Hays draft gages (wind box, furnace, uptake), and Liquidometers (two for the 12,000 gal. Bunker C tanks, one for the 5000 gal. No. 2 oil tank). Oil input is metered by two Niagara meters. Steam flow on both process and heating lines is measured by Minneapolis-Honeywell flow meters. ♦♦



"Interrupting duty does creep up"

Is your motor control just *half safe?*

G. W. HEUMANN
Industry Control Department
General Electric Company



WHY SETTLE for partial protection in your motor controllers? Modern equipment can provide the full protection you need with all the advantages of years of trouble-free, safe operation.

Standard motor controllers are rated in horsepower. They have sufficient thermal capacity to carry rated motor current, together with operating overloads, up to stalled-rotor currents. Ac controllers, which constitute the bulk of motor controllers connected to general power distribution systems, are capable of making and breaking the stalled-rotor currents of squirrel-cage motors. Under NEMA Standards for Industrial Control, they can interrupt 10 times rated full-load motor currents. Such interrupting capacity is adequate to handle operating overloads. Capacity is, in general, entirely inadequate for clearing short circuits that may occur in the branch circuit between controller and motor.

Short circuits cannot be avoided entirely, no matter how carefully a power system has been designed and installed. Only available remedy is to design the power system to mitigate destructive effects when short circuits occur. Motor branch circuit is the last link in the power distribution system between generation point and utilization point. A short circuit on a motor branch circuit that is not cleared properly endangers not only the power system but also personnel.

Fault currents that may flow in a motor branch circuit bear no relationship to the rating of the motor served by the circuit. Short-circuit current at the fault point of a motor branch circuit is largely determined by the type of transformer feeding the motor branch circuit. In the upper sketch, a motor drawing 5 amperes is connected to the power system through a small capacity transformer that permits flow of 1000-ampere fault current. In the lower sketch, the same motor is connected to a transformer having a capacity 10 times as great. Since its impedance now is only one-tenth as great

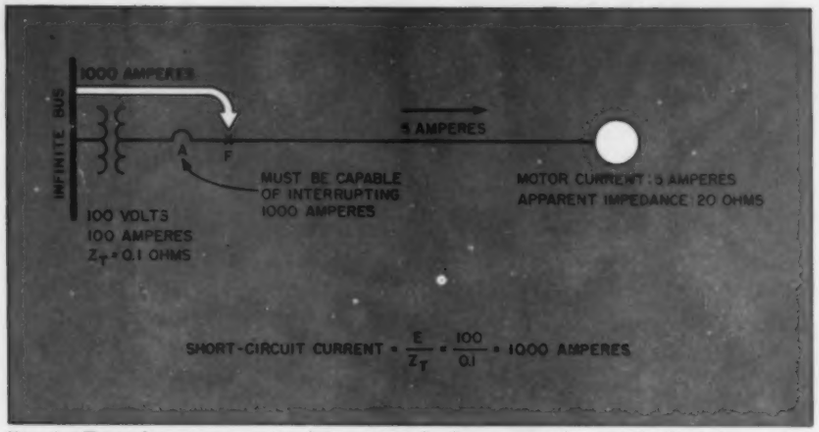


Fig. 1—Transformer capacity determines fault current that might be interrupted.

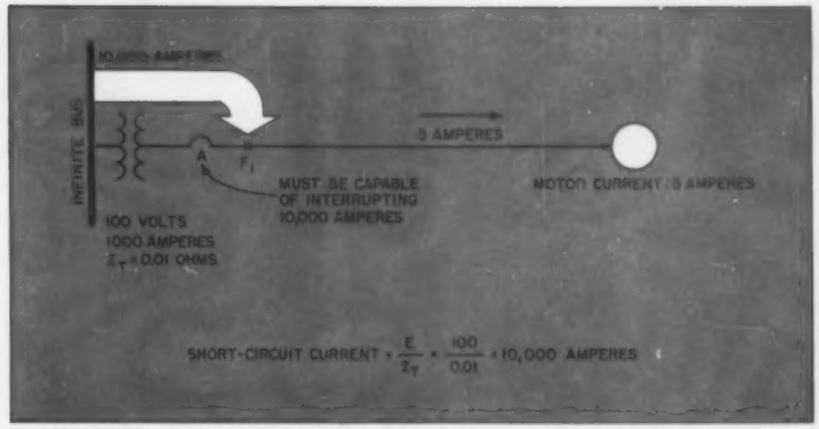


Fig. 2—With transformer of 10 times size, fault current can be 10 times greater.

as before, a fault current of 10,000 amperes may flow. Fault currents, greatly in excess of standard general-purpose controllers, may flow under short-circuit conditions (Figs. 1 and 2).

Motor controller and branch-circuit protectors would blow up unless adequate interrupting capacity were designed into the combination.

how to provide short-circuit protection

National Electrical Code prescribes that each motor branch circuit be equipped with short-circuit protective devices. They must function in the presence of short-circuit current flow. Short-circuit protection to branch-circuit equipment can be accomplished by:

- Building high interrupting ability into the controller itself so that the main controller contacts interrupt motor load as well as fault currents. For economic reasons this is not done generally for controllers (600-volts and less), but it is often done on high-voltage (601- to 4800-volts) controllers.
- Using a combination general-purpose controller, the contacts of which interrupt motor load currents, and a circuit breaker or a set of fuses for fault current interruption. This combination is usually supplied on low-voltage installations, and is frequently used on high-voltage equipment.

There is widespread belief among power users that a motor controller, "backed-up" by a circuit breaker of adequate interrupting rating, provides proper protection for a branch circuit. Such a combination may or may not be safe. Interrupting characteristics of the circuit interrupter, and thermal and mechanical strength of the controller must be carefully coordinated. Any circuit interrupter requires a finite time interval between initiation and interruption of the short circuit. During this interval, the let-through current flows through the controller. If the let-through current is too great, thermal stresses may be too high, resulting in damage to controller parts. Internal short circuits may cause the controller to explode. Peak let-through currents may result in magnetic forces that can cause deformation or breakage. Currents also may cause hazardous internal short circuits.

Because no destructive short circuits have occurred on a particular branch circuit, there is no assurance that short circuits will not occur in the future. They may happen at any time without warning.

Serious accidents may be caused by failure of low-voltage controllers under short circuit. Industrial accident records are seldom published, unfortunately, and it is difficult to find reliable reports on electrical accidents. The State of California Department of Industrial Relations issues annual reports on electrical work injuries. Two cases are listed in the reports for 1954, which can be ascribed to inadequate controller performance under short-circuit conditions.

Two accidents occurred on ac reversing controllers that had one set of contacts frozen. In an attempt to free the frozen contacts, the operators inadvertently closed the second set of contacts, thereby short circuiting the incoming lines. As a result, the controllers blew up, causing severe flash burns to the operators. The fact that short circuits caused severe controller damage indicates improper coordination between controller and short-circuit interrupting means.

Short circuits cause accidents

Far more serious accidents may be caused by short circuits on high-voltage systems. Far too many controllers are still in service today with inadequate interrupting ability, backed up by 8-cycle, oil-filled circuit breakers. Depending on relay setting, the total time during which short circuit current flows may be somewhat longer than eight cycles. Hazards with controller installation of inadequate interrupting ability on high-voltage motor branch circuits are illustrated by the following case histories.

- A semiautomatic starter of low interrupting capacity was installed on a branch circuit serving a 200-hp, 2300-volt synchronous electric motor. A motor winding faulted to ground. When the starter was manually closed, a short circuit was initiated, which was cleared by the feeder backup breaker. Starter was burned up completely before the fault was interrupted. Serious injury to the operator was prevented by dead-front starter construction.
- A manual, oil-immersed, autotransformer starter, having an interrupting capacity of 10 times rated motor current, was used on a 2300-volt induction motor. A fault developed somewhere in the branch circuit. When the operator closed the starter, a short circuit was initiated. The starter burst, the oil caught fire, and the operator was killed. The feeder breaker ahead of the starter had inadequate interrupting capacity and exploded. The fault was finally cleared by a substation breaker on the high side of the transformer.

NEMA revised standards

Potentially more lethal effect of high-voltage controller failures has caused NEMA to no longer recognize as standard those high-voltage ac controllers with an interrupting capacity of 10 times motor current. Very few power systems exist today that produce sufficient short-circuit current to provide safe branch-circuit protection using a 10 times current controller plus backup breaker. NEMA recognizes as standard only Class E controllers with stated high-interrupting capacity.

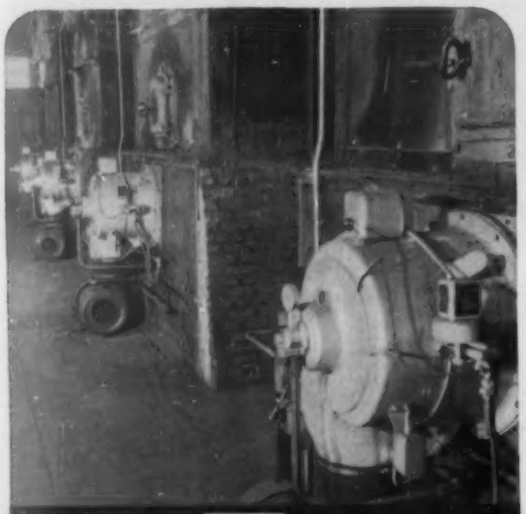
Standard low-voltage starters, in combination with properly selected inverse-time circuit breakers or fuses, provide adequate overload and short-circuit protection for motor branch circuits. Circuit breakers or fuses may be installed separately from the starter. Industrial control manufacturers offer combination starters that perform as regular starters as well as protect against faults. In a combination starter, a standard starter is coordinated with a

(continues on page 54)

Keep Firing Costs Down

on

furnaces — ovens — vats — kilns — heaters
vessels — boilers — dryers — heat exchangers



Install O&S OIL, GAS OR COMBINATION BURNER SYSTEMS

Now . . . the same efficient O&S burners that help to give O&S *Powermaster* packaged boilers their outstanding dependability and economy are adaptable to existing boiler installations and other kinds of industrial heat exchangers!

O&S burner systems are *complete* packaged combustion assemblies for gas, light or heavy oil, or combination gas/oil firing. They include burner, automatic controls, forced draft air supply, full modulation firing control, ignition, complete piping and wiring, refractory required for proper installation in combustion chamber. Many of these units are now in service—proving their cost-saving advantages on a wide variety of applications. They provide the greatest flexibility of application available in burner assemblies for modernization of existing equipment or for new installations.

If you are looking for ways and means to improve fuel-burning efficiency and performance on oil or gas fired equipment, it will pay you to get full information on O&S burner systems. Send for Bulletin 1231.

Builders of Dependable Boilers Since 1885

ORR & SEMBOWER, INC.

Morgantown Road, Reading, Pa.

Circle 139 on READ-N-CIRCLE card for more data

Pumps for emergency water supply

SAVE City of Springfield $22,905

S. T. ANDERSON, General Superintendent
Dept. of Water, Light, and Power; Springfield, Ill.

FOUR 26,500-gpm, 30-inch, propeller pumps installed to prevent shutdown of the City of Springfield's (Illinois) Lakeside Power station have turned in a 5-month saving of $22,905.00.

Water level in Lake Springfield dropped from a normal sea-level elevation of 560 feet to an elevation of 542 feet. When the level dropped below 550 feet, poor suction prevented circulating pumps from supplying adequate cooling water to turbogenerator condensers. Only three of the five turbogenerators could be operated without entirely losing pump prime or condenser vacuum, or both. This allowed enough power for community needs, but resulted in loss of revenue since the plant has a contract to sell part of its electric power to the Central Illinois Light Company. Low-pressure pumps serving the community water supply also lost prime and capacity when the lake level fell. These combined factors would have caused complete failure of water and power supplies if immediate corrective action had not been taken.

Burns and McDonnell, consulting engineers, were called in. A three-part program was agreed upon. First, new impellers were installed in existing plant pumps plus an emergency pump inside the plant

Two Fairbanks-Morse 50,000 gpm pumps raise water from Sangamon River to maintain lake water level.

A. V. Massaro, assistant electric production superintendent, inspects installation at intake tower.

to pump water from one intake tunnel to the other. Second, Fairbanks-Morse high-capacity booster pumps installed at the intake tower in the deepest part of the lake pump additional water to the plant, and raise water level in the intake tunnels. Third, a dam was constructed across the nearby Sangamon River. Pumps raise this water into Lake Springfield.

Intake tower modifications were necessary before pumps could be installed. A 300-ft bridge was built to expedite movement of men and materials.

Booster pumps and motors are mounted in the open on a steel and concrete platform outside the intake tower. All-weather pump motors are connected by 800 feet of direct burial cable from the plant to the shoreline and 300 feet of submarine cable from shore to tower. Starters for the pump motors are inside the power plant.

In addition to keeping the plant in operation, the booster pump installation significantly decreased station power expenditures. Power sales and production economies as a result of the booster pump operation totaled $32,936.00.

Power to run the booster pumps cost $7,200.64 during 154 days of operation. Total operator cost was $2,705.70. Maintenance labor was only $125.00. Since total operating costs were only $10,031.00 and total savings $32,936.00, Lakeside Plant realized a profit of $22,905.00 as a result of the increased efficiency of the booster pump installation. ♦♦

Air Conditioning and Refrigeration I--vapor compression refrigeration

JOHN F. LEE
Professor of Mechanical Engineering
North Carolina State College
with DONALD HARTLEY, Managing Editor

Start right now to review the principles related to day-to-day air conditioning and refrigeration problems. Each article in IP's POWER BASICS will cover some facet of air conditioning or refrigeration that will help you do your job better. Each one can be read without reference to the others and without any loss of continuity. Single sets of the complete series will be available without charge. Send in your request now. We will hold it until complete set is ready. Quantity prices upon request.

MODERN REFRIGERATION has replaced the non-cyclic cooling processes of melting ice and subliming solid carbon dioxide by a closed system that undergoes a thermodynamic cycle. To better understand this cycle, we must go back and look at the Carnot cycle.

In a Carnot power cycle, heat is added at a certain temperature and a smaller quantity of heat is rejected at a lower temperature. Difference between heat added and heat rejected is equivalent to the net work delivered by the system to the surroundings. Heat is converted into work. A Carnot cycle attains higher thermal efficiency than any other heat engine operating between the same temperature limits.

reversed power cycle

Now suppose the processes of a Carnot engine are reversed so that the cycle is traversed in a counter-clockwise rather than in a clockwise direction. This is the cycle followed by the refrigerant in a Carnot refrigerator and is shown on the T-s diagram (Fig. 1) with the cycle beginning at point *a*. A constant-entropy compression takes place from *a* to *b*, followed by an isothermal condensation process *bc* in which heat is rejected to atmosphere at temperature T_R. Then the constant-entropy expansion process *cd* takes place, followed by an isothermal vaporization process *da*. Heat is absorbed from the refrigerated space at a low temperature T_A. Heat Q_A flows into

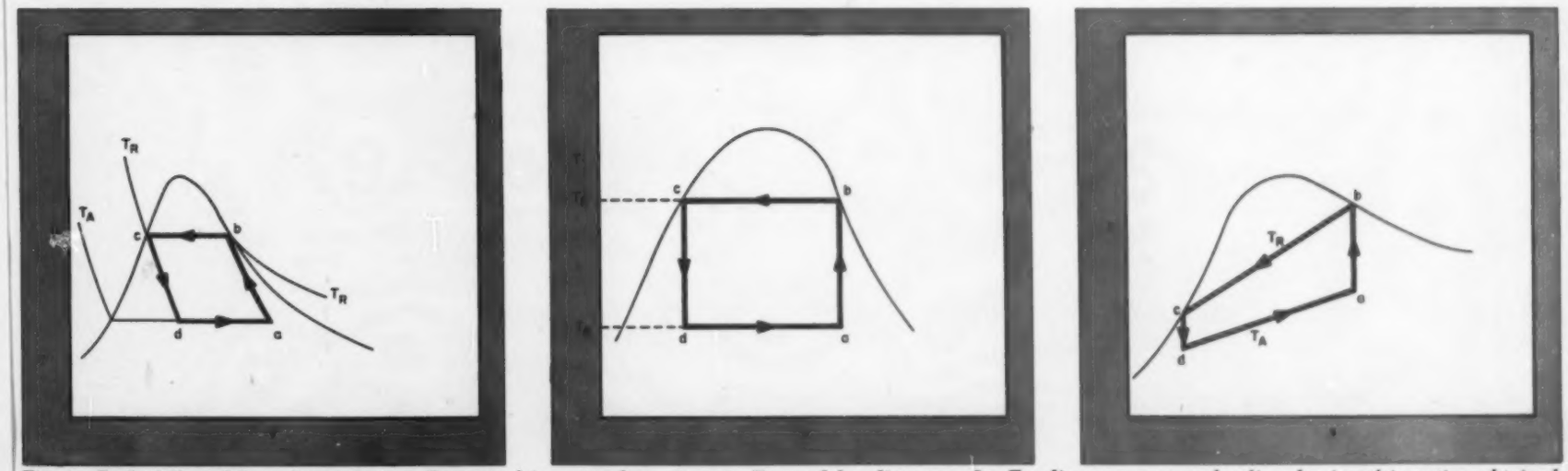


Fig. 1—Cycle followed by refrigerant in a Carnot refrigerator shown on p-v, T-s, and h-s diagrams. On T-s diagram, area under line d-a is refrigeration obtained.

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the system from a source at a low temperature T_A. Heat Q_R, equal to $W + Q_A$, is rejected to a sink at a higher temperature T_R because work is done on the system. Area under line *da* is the *refrigeration* obtained while area of T-s diagram is equivalent to the net work done on the refrigerant during the interval of one complete cycle.

coefficient of performance

What we get from operating a refrigerator is heat Q_A being removed from the low-temperature source or refrigerated space. What we pay for is the work input, *W*. The greater the ratio of "what we get" to "what we pay for," the more efficient the refrigerator. Refrigerators are rated by this ratio, called *coefficient of performance*, or

$$\text{cop} = \frac{Q_A}{W} = \frac{Q_A}{Q_R - Q_A} \qquad (1)$$

Unlike power cycle efficiency, the refrigerator coefficient of performance can be considerably larger than 100 percent. For a Carnot refrigerator, the coefficient of performance is:

$$\text{cop} = \frac{Q_A}{Q_R - Q_A} = \frac{T_R\ (s_a - s_d)}{T_A\ (s_a - s_d) - T_R\ (s_a - s_d)} \qquad (2)$$

and is the highest that can be achieved by a refrigerator operating between the same temperature limits. Note that Eq. (2) is for the coefficient of performance of a Carnot refrigerator only but Eq. (1) is applicable to any refrigerator.

Carnot refrigerators have been made using a condensable vapor, such as ammonia or "Freon-12", as the working substance. Carnot engines can cope easily with the isothermal process involved. Since the pressure and temperature ranges of the Carnot refrigerator are small, the work of compression and expansion is also small. If air, or some other gas, is used as the working substance, the isothermal processes are difficult to attain. Problem is eliminated by operating on a reversed Brayton cycle instead of a reversed Carnot cycle. In effect, this means substituting constant-pressure processes for the isothermals of the Carnot refrigerator.

vapor-compression refrigeration cycle

Vapor-compression refrigerators may operate as Carnot refrigerators. But to approximate isentropic expansion *cd*, shown in Fig. 1, refrigerant would have to expand behind a piston. Resulting mechanical work would be utilized to do part of the work of the compression in process *ab*. Savings from salvaging the work of expansion are more than offset, however, by the added mechanical complexity. Reversible expansion is, therefore, replaced by an irreversible constant-enthalpy expansion through a throttling valve.

Refrigeration cycle is shown in the T-s and h-s diagrams of Fig. 2 where *cd* is the throttling process. Vapor-compression refrigerator is shown schematically in Fig. 3. Letters *a*, *b*, *c*, and *d* correspond to the

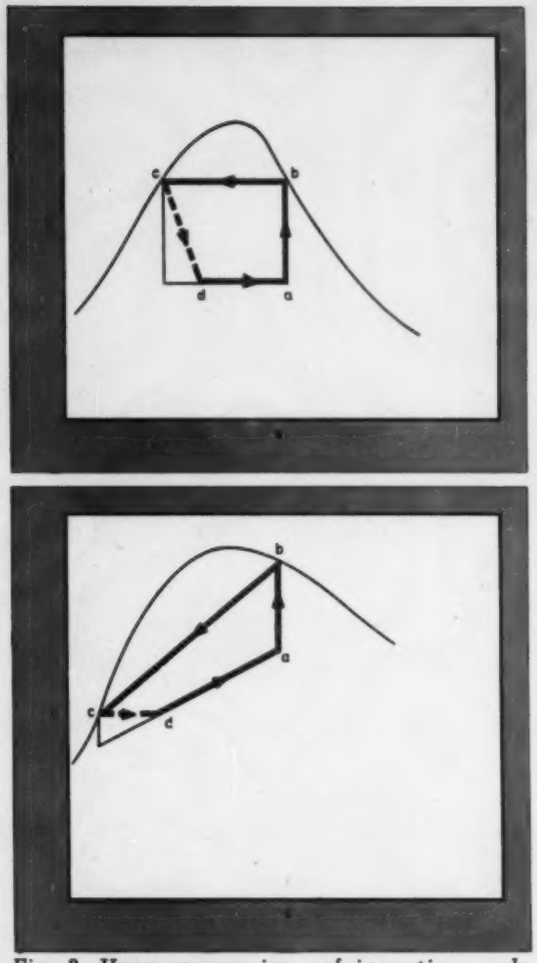

Fig. 2—Vapor-compression refrigeration cycle, on T-s and h-s diagrams. c-d is throttling process.

same letters in Fig. 2. In the ideal cycle, refrigerant enters the *throttling valve* at point *c* and leaves at *d* at constant enthalpy. Some flashes into vapor during this process. Refrigerant enters *evaporator* at *d* as a 2-phase mixture and abstracts heat from the refrigerated space at constant temperature T_A and constant pressure in the vaporization process *da*. Refrigerant may leave evaporator as a 2-phase mixture (Fig. 2), a saturated vapor (Fig. 4a), or as a slightly superheated vapor (Fig. 4b). Ideally, the refrigerant is compressed to condenser pressure in constant-entropy process *ab*. Heat is rejected from the *condenser* to atmosphere or cooling water in process *bc*, (Fig. 2 or Fig. 4).

Coefficient of performance of the vapor-compression refrigerator is given by Eq. (1), or

$$\text{cop} = \frac{Q_A}{Q_R - Q_A}$$

Since $Q_A = h_a - h_d$, $Q_R = h_b - h_c$, and $h_c = h_d$,

(continues on page 25)

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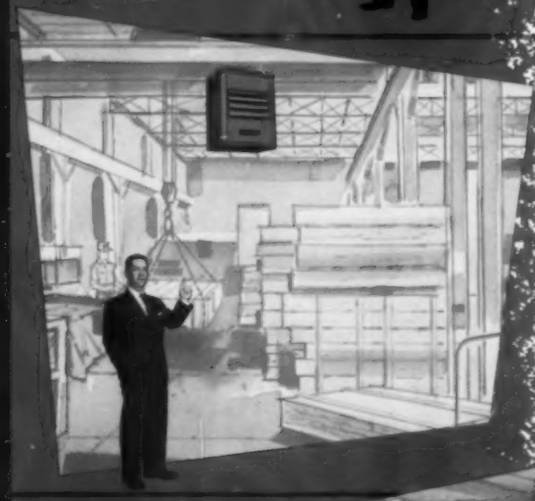
"Let me show you how we solved all our plant heating problems with Reznor Gas Unit Heaters"

"Our engineers were always complaining about the cold until we installed Reznor heaters in the drafting room"

"Our steam heating system does a good job out in the plant where temperature levels don't need to be as high or as steady, but we've always had trouble keeping office workers comfortable. So we installed these Reznor gas unit heaters in the drafting room. It worked out so well we're using Reznor heat in all office areas now. Reznor heaters are doing a better job for us in these areas because they respond instantly, automatically to the temperature requirements of their immediate surroundings. Reznor suspended units are fine here in the drafting room. In other office areas, where floor space is at less of a premium and appearance more important, we've used Reznor floor models. We even installed them in the executive offices, and they've helped sell management on Reznor heating."



"Rust was eating away our warehouse stocks; these Reznor heaters put a stop to it"

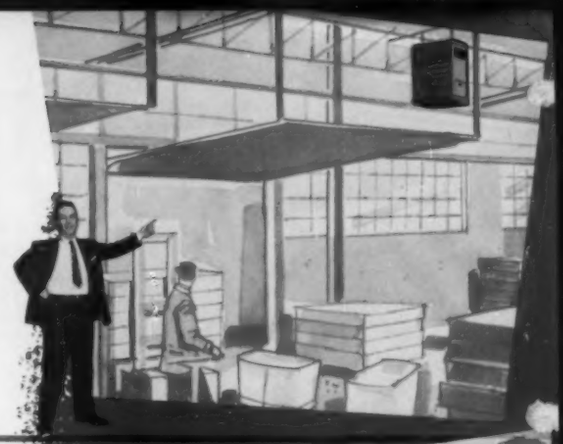
"Rust used to be a serious problem at both ends of our production lines. It attacked our supply of sheet metal. And it caused trouble in the warehouses where we stockpile our finished products. One way or another rust was costing us thousands of dollars a year; we could have afforded to pay plenty to stop it. But we didn't have to! Reznor gas unit heaters proved to be the efficient, economical answer to our rust problems. We installed a few Reznor heaters in our steel warehouse and a few more here in our finished products warehouse, set the thermostats and forgot them. Rust is no longer a problem. The heaters are no problem, either. Operating costs are lower than we had expected, and maintenance costs have been zero."

"Our boilers didn't have the extra capacity to handle this plant addition . . . Reznor heaters were the perfect solution"

"When we completed this new plant addition, our boilers weren't able to take the additional heating load. It wasn't going to be economical to add another boiler, or to replace one of our boilers with a boiler of larger capacity. Reznor heaters were the perfect solution for our problem. Eighteen 150,000 BTU Reznor heaters gave us the required capacity and they maintain an even, comfortable temperature throughout the new section of the plant. Installation costs were surprisingly low. Operating cost has been less than that for the same capacity from the steam system, and we've had absolutely no maintenance work to do. When our present boilers need replacement, we'll probably switch the whole plant to Reznor gas unit heating."

"Heat loss through these shipping room doors was tremendous until Reznor suggested this answer"

"Until these Reznor heaters were installed, our shipping room crew might as well have been working outside during cold weather. Whenever those big doors were open, the cold wind came blasting in, making everybody uncomfortable, unhappy, and inefficient. Reznor gas unit heaters have eliminated all that. Installed so they discharge across the door areas, they lay down a curtain of warm air which keeps winter outside where it belongs. And they operate completely automatically . . . putting out a powerful blast of heat within a few seconds after the doors are open. The lesson we learned here has been applied to eliminate trouble spots in other parts of the plant, too. It's paid off in better health, morale and efficiency among our workers."



"We saved $120,000 here by installing Reznor heaters instead of replacing a worn-out boiler"

"When the old heating boiler at this plant gave out, we were told it would cost $150,000 to replace it. Then we discovered we could have a Reznor heating system for approximately one-fifth of that cost. It's a big building . . . 165,000 square feet of space to be heated. It took 64 Reznor heaters and over 20,000 feet of pipe to do the job, but we saved $120,000 on equipment and original installation. And we're saving a lot more on operation and maintenance costs. For example, we saved $15,000 a year in salaries by eliminating the four men formerly needed to operate the boiler room. And the plant is more comfortably heated than it ever was before."

"We select Reznor heaters to do the whole job at our new East St. Louis plant because . . ."

"All the experience we've had with Reznor in our other plants has been 100% good. And when we added up the pros and cons on the heating system for this new plant, they came out heavily in favor of Reznor again. Here's some of the reasons why: Lower original equipment costs. Much lower installation costs. No valuable floor space required for any heating equipment, no space required for fuel storage. Low fuel costs. No maintenance problems — maintenance is mostly a matter of one cleaning a year.

"Dollars and cents clinched the job for Reznor, but there are other advantages, too. Worker comfort is important to us, and everywhere we've tried it, Reznor heat has been the most comfortable heat we've ever had. Reznor contributes to worker comfort even during hot weather, because those big powerful fans can be turned on to provide cooling air circulation."

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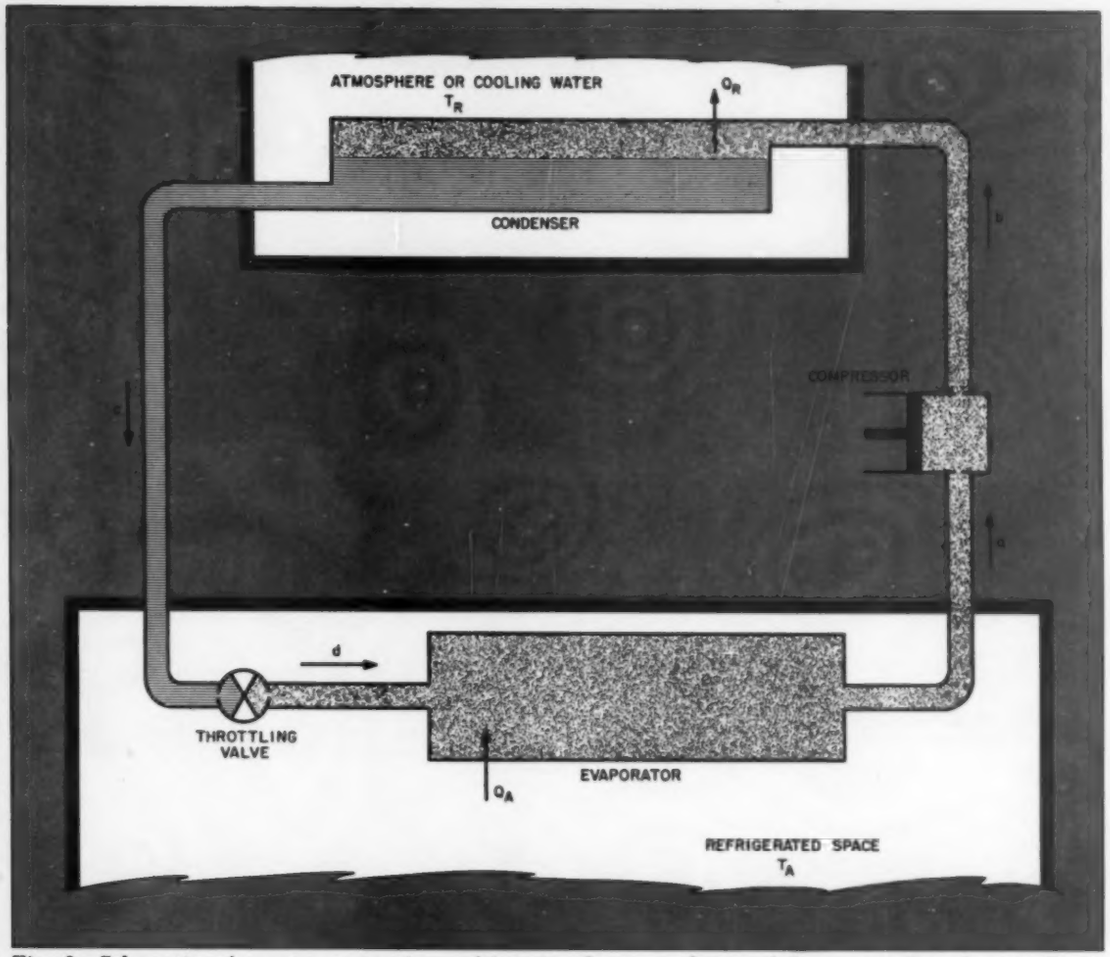

Fig. 3—Schematic of vapor-compression refrigerator. Letters a, b, c, and d correspond to those in Fig. 2.

the coefficient of performance can be written as

$$\text{cop} = \frac{h_a - h_d}{(h_b - h_c) - (h_a - h_c)} = \frac{h_a - h_d}{h_b - h_a} = \frac{h_a - h_c}{h_b - h_a} \quad (3)$$

Actual coefficient of performance must take into account the effect of inefficiencies in individual processes as well as heat losses to or heat gains from the surroundings through walls of interconnecting piping.

Either evaporator and condenser pressures or temperatures of the atmosphere (or cooling water) and refrigerated space will be known. Enthalpies h_c and h_d, therefore, may be found directly from tables of thermodynamic properties of the particular refrigerant used. Note that the refrigerant is a saturated liquid at point c, and a saturated vapor at point b (Fig. 2). Since $s_a = s_b$ and the temperature and pressure at *a* are known, h_a also may be read directly from tables. Inefficiencies in the compressor may be taken into account through use of the compressor efficiency.

Fig. 4 shows the vapor refrigeration cycle on T-s and h-s diagrams when refrigerant leaves the evaporator as a saturated or superheated vapor. In this case, compression occurs entirely in the vapor region, resulting in what is called *dry compression* as opposed to *wet compression* shown in Fig. 2. Principal advantage of using dry compression is the elimination of possible damage to the compressor. Poorer compression efficiency, caused by liquid refrigerant entering the compressor and not being completely evaporated during the compression process, is also avoided.

Performance coefficient can be improved by subcooling the liquid refrigerant leaving the condenser. This results in point c being moved down on the saturated liquid line. Subcooling the liquid refrigerant leaving the condenser and eliminating the superheating necessary for dry compression decreases the difference between the mean effective temperatures at which heat is rejected and absorbed. *Smaller* differences give higher performance coefficients. With a power cycle, of course, the converse of this applies.

ton of refrigeration

Refrigerator capacity is the rate at which refrigeration is produced. This rate is expressed in tons of refrigeration for convenience. A ton of refrigeration is defined as 288,000 Btu in a 24-hour period. This is the rate of refrigeration obtained when a ton of ice is melted in a 24-hour period, assuming that the latent heat of fusion of ice is 144 Btu/lb. More conveniently, a ton of refrigeration is expressed as 12,000 Btu/hr or 200 Btu/min.

Rate of work input is measured in horsepower or kilowatts. We may express horsepower input per ton of refrigeration, therefore, in terms of the coefficient of refrigerator performance as follows:

$$\frac{\text{hp}}{\text{ton}} = \frac{\dfrac{W_{net}\ \text{Btu/hr}}{2545\ \text{Btu/hp-hr}}}{\dfrac{Q_1\ \text{Btu/hr}}{12{,}000\ \text{Btu/ton-hr}}}$$

$$= 4.715\,\frac{W_{net}}{Q_1}$$

$$= \frac{4.715}{\text{cop}} \quad (4)$$

EXAMPLE. A vapor-compression refrigerator using "Freon-12" as a refrigerant has an evaporator pressure of 16 psia. Vapor leaves the evaporator at 0 F and enters the compressor at 10 F. (Increased temperature is caused by heat gains in the connecting piping.) Internal work done by the compressor is 25 Btu/lb and heat losses from the compressor amount to 1.5 Btu/lb. A loss of heat occurs in the piping between compressor and condenser amounting to 0.5 Btu/lb. Refrigerant leaves the condenser as a saturated liquid at 70 F and enters the expansion valve at condenser pressure but at a tem-

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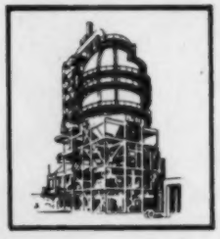

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perature of 68 F. If 10 tons of refrigeration are produced, determine (a) how much heat is rejected from the condenser per minute, (b) coefficient of performance, and (c) horsepower per ton of refrigeration.

SOLUTION. In solving this problem we use the

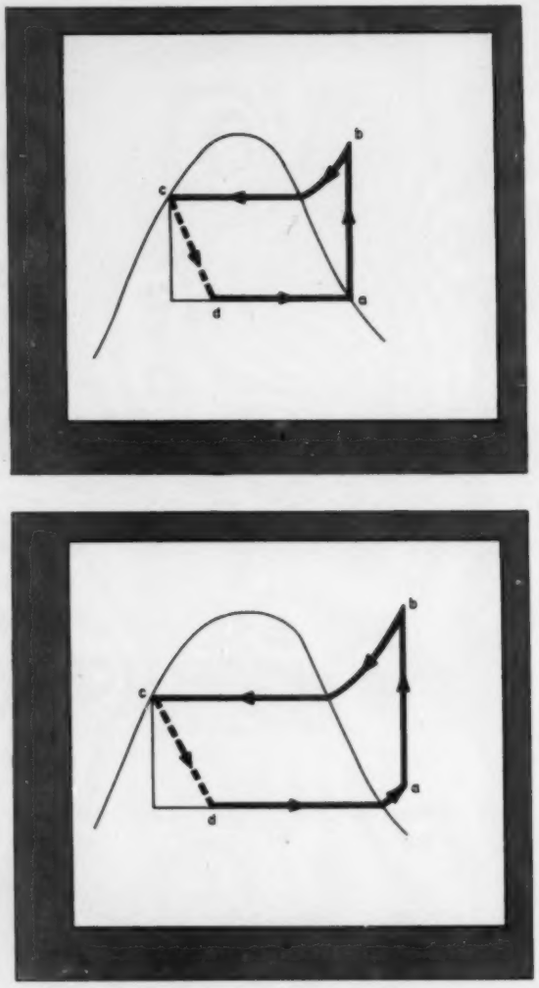


Fig. 4—Refrigerant may leave evaporator as saturated vapor (top), or as slightly superheated vapor.

"Freon-12" tables. A *T-s* diagram (Fig. 5) will help in following the cyclic process and in identifying the pertinent states.

Entering the "Freon-12" tables with the evaporator pressure of 16 psia and a temperature of 0 F, we find that the refrigerant is superheated. This is point *d* in Fig. 5 and $h_d = 78.58$ Btu/lb. Vapor is superheated further to a temperature of 10 F before entering the compressor at *e*, and $h_e = 79.94$ Btu/lb. Enthalpy increase due to compression work is

$\Delta h = h_f - h_e = Q - W$
$= -1.5$ Btu/lb $-$ (-25) Btu/lb
$= 23.5$ Btu/lb.

Therefore, we have
$h_f = h_e + \Delta h$
$h_f = 79.94$ Btu/lb $+ 23.5$ Btu/lb
$= 103.44$ Btu/lb.

Enthalpy entering condenser is
$h_g = 103.44$ Btu/lb $- 0.5$ Btu/lb (piping loss)
$= 102.95$ Btu/lb.

Enthalpy of saturated liquid leaving the condenser is obtained from the "Freon-12" tables, and $h_l = 23.9$ Btu/lb. Temperature drop from 70 F to 68 F between condenser and expansion valve is due to heat losses to the surroundings. Enthalpy of the subcooled refrigerant at a temperature of 68 F is found from the "Freon-12" tables to be $h_a = 23.43$ Btu/lb.

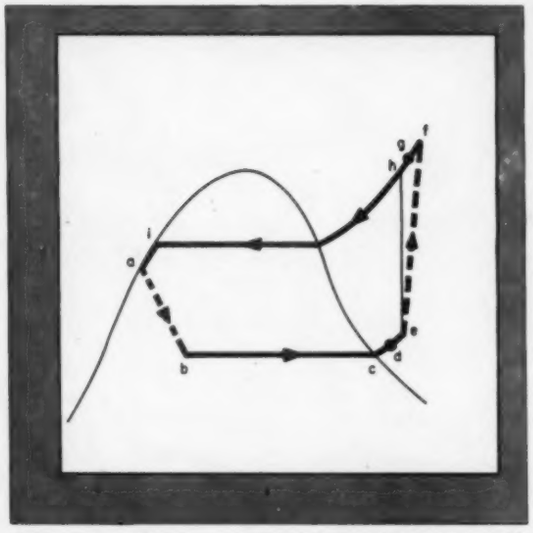


Fig. 5—T-s diagram is useful in following cyclic process and in identifying various refrigerant states.

We now have all the information needed to solve the problem. Heat rejected from the condenser is
$q_R' = h_g - h_l = 102.94 - 23.9 = 79.04$ Btu/lb
Refrigeration is
$q_{ref} = h_d - h_a = 78.58 - 23.43 = 55.15$ Btu/lb
Mass rate of flow of refrigerant is

$$\frac{10 \text{ tons} \times 200 \text{ Btu/ton/min}}{55.15 \text{ Btu/lb}} = 36.3 \text{ lb/min}$$

(a) Heat rejected from the condenser per minute is

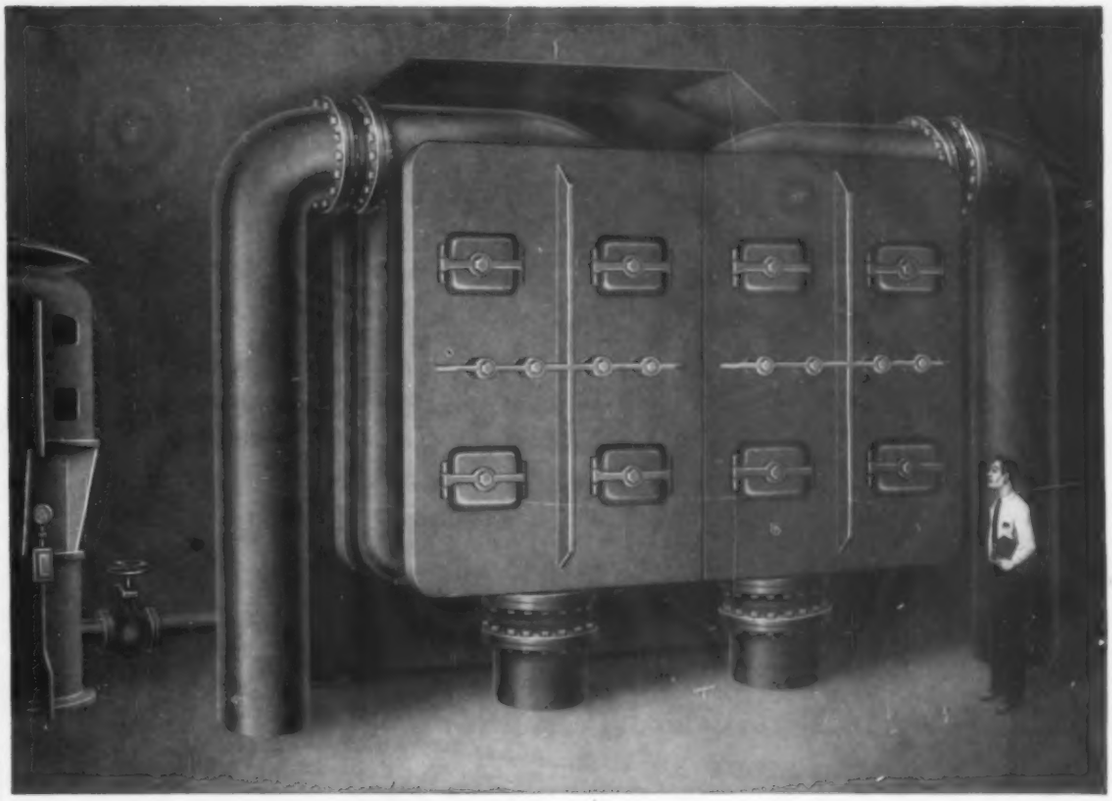
$$Q_R = 36.3 \frac{\text{lb}}{\text{min}} \times 79.04 \frac{\text{Btu}}{\text{lb}} = 2870 \text{ Btu/min}$$

(b) Coefficient of performance is

$$\text{cop} = \frac{q_{ref}}{w_{net}} = \frac{55.15 \text{ Btu/lb}}{25 \text{ Btu/lb}} = 2.2$$

(c) Horsepower required per ton of refrigeration is obtained from Eq. (4) as

$$\frac{\text{hp}}{\text{ton}} = \frac{4.715}{2.2} = 2.14.$$ ♦♦



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Compressed air

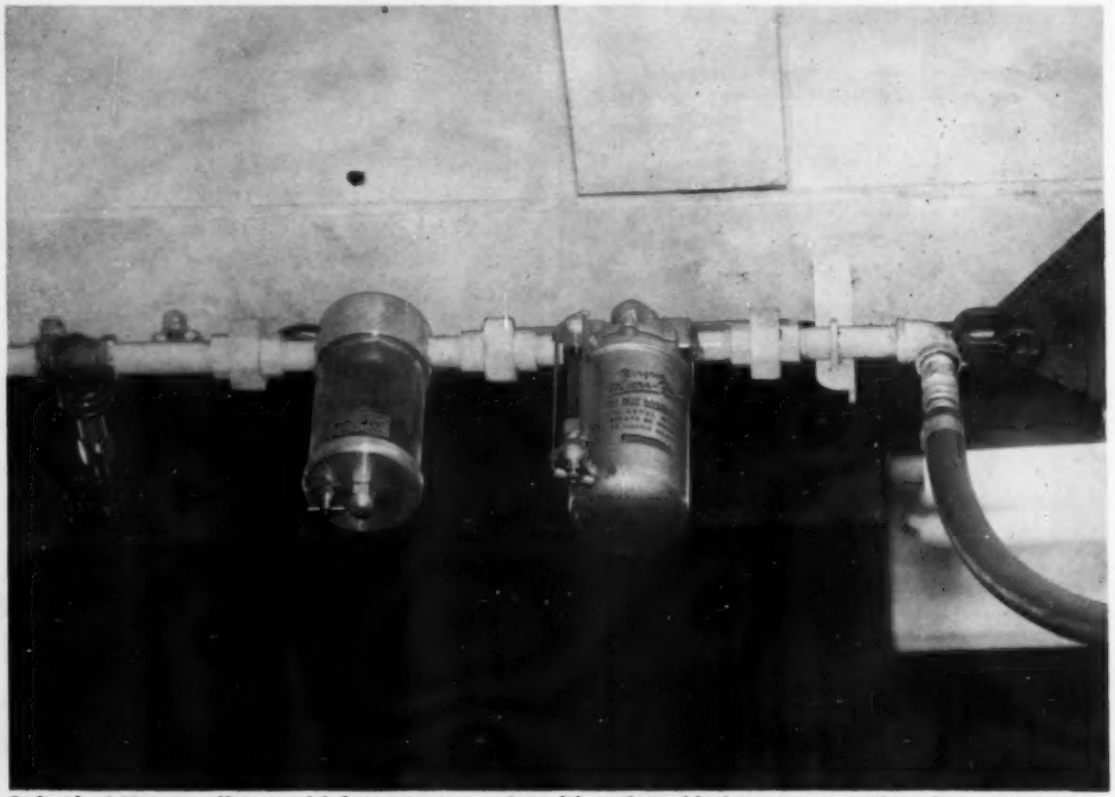
. . . starts on page 12

to start and stop the compressor according to plant compressed air demand.

Compressed air is delivered at each building column throughout the plant to provide for all immediate and future needs. System piping consists of 2800 feet of 8-inch welded piping and 12,000 feet of 2½-inch, 2-inch, 1½-inch, 1¼-inch and 1-inch piping.

throughout the entire system to give adequate air supply to all locations. To date, Caterpillar's engineers have experienced little or no difficulty in eliminating moisture from the system.

In general, each piece of air-driven equipment has its own separate Norgren lubricator. Individual filters and lubricators were selected because airflow from 2 to 9 cfm were required through lubricators to get best lubrication. This was accomplished by providing separate lubricators for each piece of equipment. Lubrication and operation of air-driven equipment has presented no problems to date.



Individual Norgren filters and lubricators insure long life and trouble-free operation of air-driven equipment.

Compressed air piping system was pressure-tested after completion at 200 psig for a period of 2 hours with a minimum permissible pressure drop of 1 percent.

Eight-inch main line from compressor to plant travels through a connecting service tunnel. Condensate traps are located in the compressor room and at the base of some building columns. No reservoir is used in the air system because the system itself acts as reservoir. During normal operations, two compressors are in operation. On weekends, the third compressor is operated to maintain system pressure and for emergency needs. Pipe sizes were calculated

Present compressed air system is sized 25-percent greater than present requirements. Provision of an additional radial unit will add another 33 percent.

Compressed air system at Caterpillar's Decatur plant is the result of thorough engineering investigation. The system is modern and efficient, and will be duplicated in proposed addition to the plant. Maintenance costs have been negligible and operating costs have been reasonable.

This is an example of how engineering ability coupled with previous satisfactory experience has worked hand-in-hand to give an economical, trouble-free compressed air system. ♦ ♦

CUT HERE AND FILE

CHECK NOW for better Unit Heater service

W. R. McMAHON
President, Industrial Unit Heater Association

CUT HERE AND FILE

precautions for correct installation

- Read and save manufacturer's written instructions (horizontal, vertical, and blower units each require different treatment).
- Inspect new heaters before installing.
- Make sure feed line is taken off top of steam main and is pitched toward main.
- Be sure return line is pitched so it drains freely.
- Use strainers in return lines before traps or check valves.
- Use strainers in supply lines to heaters with small diameter distributing-tube coils to prevent clogging.
- Check fan for position and tightness on shaft.
- Tighten any loose nuts and bolts.
- Ensure line voltage is adequate and constant.
- Use separate, manually operated, thermal-overload starter with properly sized fuses.

low-pressure steam gravity system

- Locate float trap or check valve at least 10 inches below bottom of heater to maintain a head of water. If not done, condensate may back up into heating element and cause trouble, such as water hammer, excessive corrosion, loss of capacity, and sometimes failure from freezing.
- Don't bush outlet—run full-size line to trap.
- Pick trap size to fit job, not pipe size.
- Be sure to install an adequate air-vent valve in closed-return systems.

vapor and vacuum-steam system

- Apply these same precautions, but omit vent valves. (If thermostatic trap is used, provide cooling leg ahead of it to prevent excess "open-and-close" cycling.)

high-pressure steam system

- Where possible, use reducing valves in supply main (lower pressures mean less corrosion, less strain, fewer chances for trouble).
- Provide petcock for air bleed (an air vent will not handle high pressure satisfactorily).
- Be sure trap is at least 10 inches below bottom of heater.

hot-water system

- Be sure air vent valves are located properly to prevent or relieve air binding.
- Make provision for draining unit in cold weather if system is shut down.

If system is "sectionalized" with shutoff valves, units may be changed without draining entire system.

In forced-circulation hot-water systems, inlet or outlet piping does not have to be pitched, although it is done sometimes to create a high point for trapping air.

general maintenance

Set up these preventive maintenance procedures —they will pay you many times over in longer life of units and parts, and also in economical operation.

SCHEDULE. In normal operation, inspect units every four months. In dirty atmospheres, increase frequency to every three months, or even less.

CHECKLIST. List five main points to be checked—motor, fan, heating element, casing, pipeline connections. Here are the things to do:

motor

- Check for loose electrical connections and excessive vibration. Check that bearings aren't worn and motor mounting hasn't worked loose.
- Wipe dirt and grime off motor casing to ensure adequate air-stream cooling.
- Follow manufacturer's lubrication instructions. Be careful not to over-lubricate. Antifriction bearings packed in grease need attention only once a year at most. If this type of bearing has a pressure-gun fitting, be sure to remove pressure-relief plug when lubricating, to allow old grease to run out. Use high-temperature grease recommended. Fill oil cups before operating a new heater, then refill after every 2000 hours of operation.

fan

- See that fan assembly is in proper position on shaft and that hub setscrews are tight. Check for loose fan blades, cracks, and bad vibration.
- Wipe blades clean at each inspection. A dirty fan will get out of balance, cause noise and excessive vibration, and may damage motor bearings.

heating element

- Check for leaks or cracks—they will be easy to spot by escaping steam or water.
- Dirt accumulated on surface and between tubing can reduce heating capacity considerably. Clean heating elements at least once a year—more often when used in dirty or corrosive atmospheres.

To clean, brush fins on fan side of unit, place a bag over its outer face, and operate fan. Use bristle brushes. When dirt is heavy, repeated tries may clear the element. For stubborn deposits, use soft bottle brush between grids, or blow dirt out with high-pressure air blasts. Always be sure to protect motor from dirty blasts. For thorough cleaning, remove heating element and spray with mild alkali cleaning solution. Rinse well afterward with steam gun.

casing

- Check all fastenings on unit and mounting supports for looseness or wear.
- Remove dirt from inside and outside surfaces. Clean off rusty or corroded areas, and retouch with paint.

pipeline connections

- Check that all pipe connections are tight. Make sure unit isn't air-bound. Inspect traps, valves, and vents for wear, leaks, and proper operation. Clean out strainers.

blower-type unit heaters

As a rule, a blower unit needs inspection at least every three months. Besides this routine maintenance, watch these points:

- Check fan shaft for end play, worn bearings, loose setscrews. Lubricate sleeve and antifriction bearings at least every three months.
- If direct-connected, check drive coupling for alignment and wear. Never replace one belt only—always install a matched set.
- Check motor holddown bolts for tightness.

Check condition of any air filters. Clogged filters reduce air circulation and heating capacity. Clean or replace filters as required. ♦♦

Storage batteries

. . . starts on page 14

ments should be divided into three groups according to load type. Customary classifications are:

- Switchgear load
- Pilot-light load
- Emergency lighting or power load.

Duration of these three loads differ—switchgear closing requires less than a second, pilot lights require continuous current supply, and emergency lighting of power equipment requires current over the emergency period.

Batteries have different capacities at different discharge rates. For this reason, the plates-per-cell requirement for load type should be found separately. Total battery size is obtained by adding the plates-per-cell required for all three types of service.

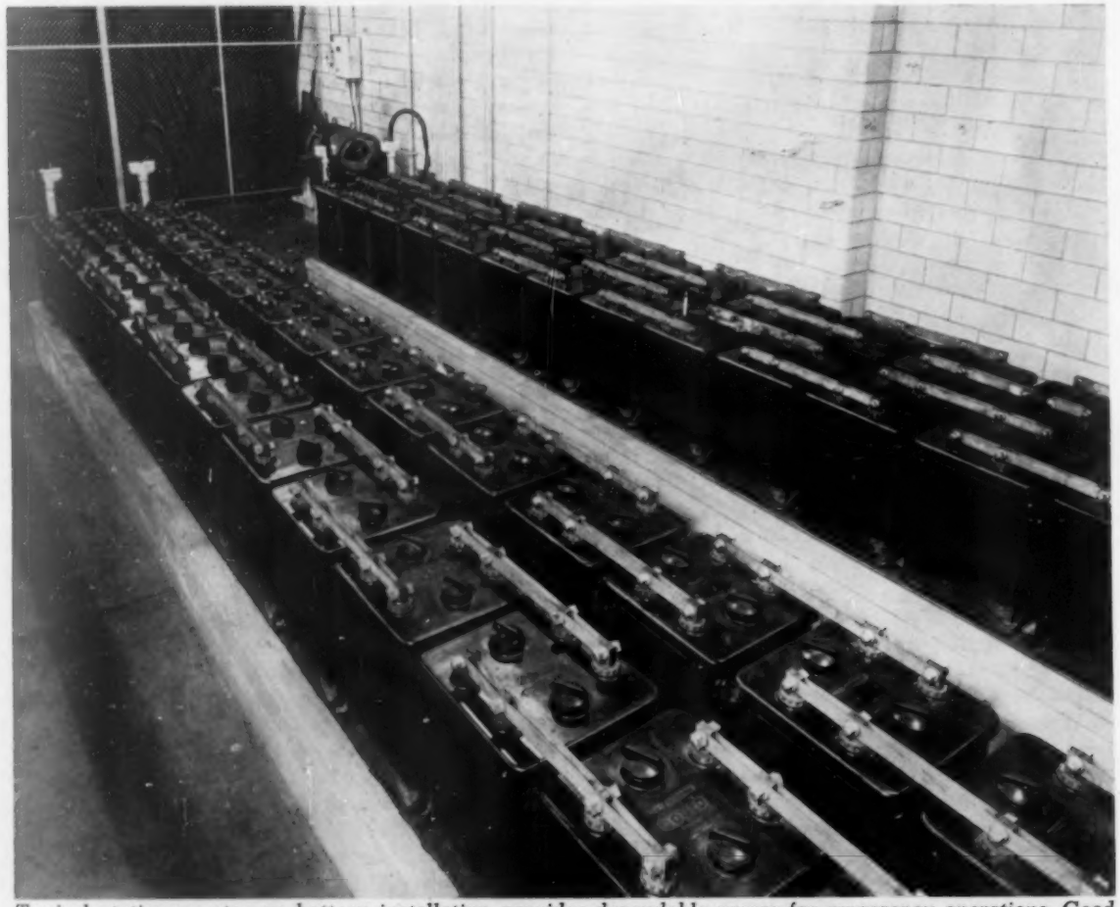
Power station control apparatus is standardized at either 120 or 240 volts which means either 60 or 120 cells. So selecting the number of cells for the control battery is a comparatively simple matter.

Plates-per-cell needed to supply energy for repeated switchgear closing is computed from the one-minute battery discharge rate. Capacity must be large enough for the combined load if more than one switch closes simultaneously. When fewer than 20 circuit breakers are installed, it is usually assumed that only one closing operation will occur at a time. A much lower current is needed for tripping than for closing. It is customary therefore, to assume that a battery with capacity for closing will have capacity for both operations. For safety, larger current requirement is used when determining battery size.

Pilot-light load is the total number of lights multiplied by the current drain of each. Time interval for pilot-light load depends on the installations (attended or unattended stations).

Total ampere load for the duration of the emergency must be determined if control batteries supply emergency lighting. Time generally varies from a few minutes to 12 hours.

Battery can be selected knowing ampere values for the three load types, and the time intervals that these loads must be carried. Manufacturer's data for each battery include: capacity per positive plate at the one-minute rate (for different size cells), capacity curve in both amperes and ampere-hours for positive plate at longer discharge rates, and temperature correction curve.



Typical stationary storage battery installation provides dependable power for emergency operations. Good housekeeping and maintenance of individual cell records keep batteries in condition to meet any emergency.

how to make temperature correction

To make temperature correction, the engineer must establish battery operating temperature conditions. Correction should be based on the lowest yearly ambient temperature. In heated stations the correction is usually too small to consider. On the other hand, temperature corrections for unattended stations become significant for safe winter operation.

Use manufacturer's data for battery under consideration to find the correct number of positive plates-per-cell. Then determine (for each load condition) the available ampere capacity per positive plate. Correct each of these values for lowest ambient service temperature. Divide these ampere capacities (in turn) into the ampere requirements for their corresponding loads. A calculated number of positive plates necessary to handle each load is thus derived. Add these figures to get total number of positive plates-per-cell. If this total shows a fraction greater than five percent of the total figure, increase the number to the next whole number. Otherwise neglect the fraction. Double this whole number and add one to get the proper number of plates (both positive and negative) per cell.

For example, select a 60-cell control battery to meet the following load conditions at a temperature not lower than 55 F.

- Switchgear Requirement—One switch requiring 90 amperes
- Pilot Light Requirement—One ampere for eight hours
- Emergency Light Requirements—Seven amperes for three hours.

Assume that a battery with characteristics as given in Fig. 2 is used.

how to select correct battery

Starting with an estimated battery size of 9 plates-per-cell (4 positive plates) first tackle the *switchgear* load. From tabular data for one-minute discharge of 1.75 volts, the capacity is 240 amperes, or 50 amperes per positive plate. From the one-minute curve (Fig. 1) a minimum temperature of 55 F reduces the amperes per plate to 82 percent. Thus, available current per positive plate is 60 x 0.82 or 49.2 amperes. Divide this figure into the 90 amperes required to close one switch. Result is 1.83 positive plates-per-cell to handle the switchgear load.

Shifting to pilot-light requirement we can establish 5-ampere capacity (40-ampere-hours in 8 hours) for the battery at the 8-hour rate. The 8-

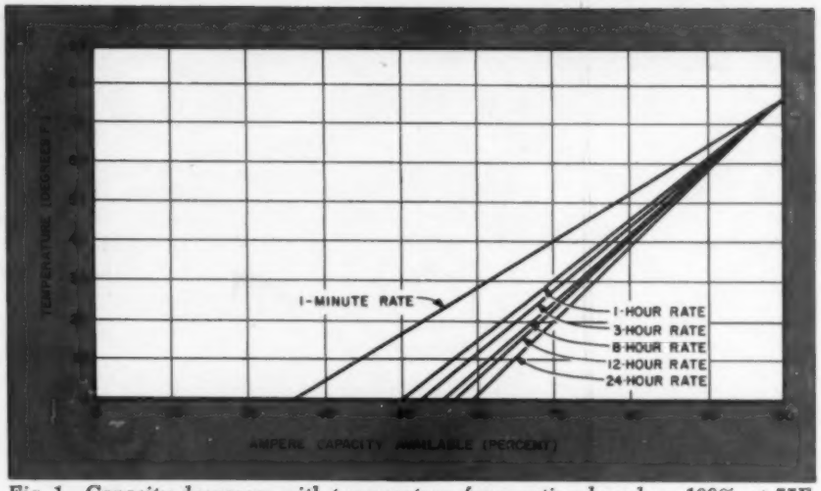


Fig. 1—Capacity decreases with temperature from rating based on 100% at 77F.

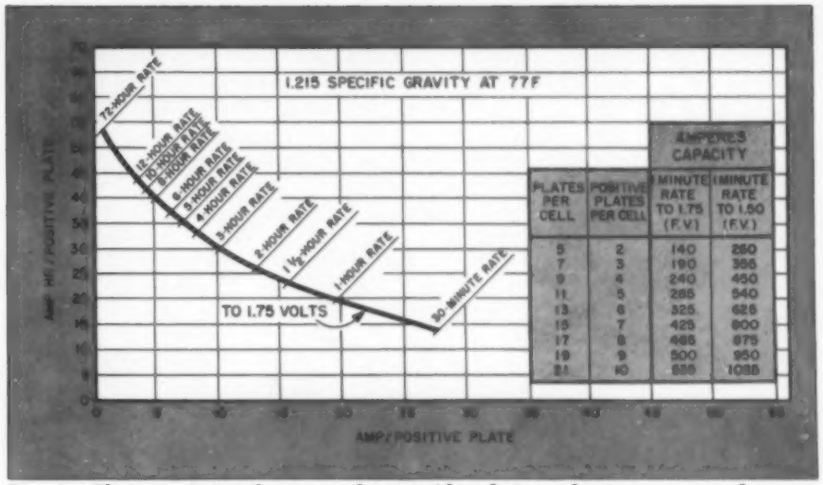


Fig. 2—Characteristics that must be considered in selecting proper battery.

hour curve (Fig. 2) shows 87.4 percent capacity at 55 F. Available current per positive plate is 5 x 0.874 or 4.37 ampere. Divide this figure into the 1-ampere requirement for pilot lights. Result is 0.23 positive plates-per-cell.

Finally, for *emergency lighting* load (3-hour service) an availability of 10 amperes per positive plate (30 ampere-hours in 3 hours). The 3-hour curve on the temperature correction chart (Fig. 2) shows 86.6 percent capacity at 55 F. Thus available current per positive plate (at the 3-hour rate) is 10 x 0.8666 or 8.66 amperes. Divide this figure into the 7-ampere requirement for emergency lighting. Result is 0.81 positive plates-per-cell.

Total positive plates-per-cell for all three loads equals: 1.83 + 0.23 + 0.81 or 2.87 positive plates-per-cell. The fraction 0.87 exceeds 5 percent of the total figure. Thus 3 positive plates-per-cell is correct.

This means that a 7-plate battery is sufficient (even for service at 55 F) and there is no need to specify the 9-plate size from which the initial calculation began.

Proper installation prevents future maintenance difficulties and should be done correctly. Follow these steps when placing a battery in service:

- Unpack battery cells carefully. Be sure all vent plugs are in place to prevent foreign material from entering the cells. Slide cells from the packing case after removing packing materials. Do not lift cells by terminals.
- Check electrolyte level of each cell. If levels are below the low level line, add sulphuric acid electrolyte of 1.210 specific gravity and raise level to ⅛-inch below high level line. If acid electrolyte is not immediately available, raise level with distilled water, to low level line. Use acid electrolyte when available, to raise level to specified ⅛-inch below high level line.
- Install battery in a ventilated room so fumes will be removed. Insulate batteries from rack to prevent possible grounding.
- Clean all terminal contact surfaces with a wire brush. Clean lead-plated copper with #00 grade sandpaper or finer, or a suede brush. Place thin film of noncorrosive grease on all surfaces to be bolted together.
- Connect cells, positive to negative, and give battery a freshening charge. Make battery-charger connections positive to positive and negative to negative. Freshening charge should be given at the finishing rate indicated in the instructions.

follow maintenance procedures

Battery is now ready for use. In operation, the following maintenance procedures are recommended for best performance.

- Maintain manufacturers' recommended float voltage at battery terminals. Battery will be automatically kept in a fully charged condition by maintaining the proper voltage at battery terminals. After a battery has been discharged, the charging rate will be increased to bring the battery back to a fully charged condition. Voltage is used as your guide and charging equipment should not be overloaded.
- Keep batteries clean, particularly the cover, so that dirt or moisture accumulation will not cause short circuits.
- Check electrolyte levels monthly. Add distilled water to maintain level between low level and high level. Do not fill above high level. Water is usually required at 6-month to 12-month intervals when correct float voltage is maintained. Using more water indicates float voltage is higher than necessary and a check should be made to determine why.
- Once a year check panel voltmeter for accuracy at operating voltage. This meter should be adjusted to read accurately at the operating voltage. Don't be alarmed if meter is not reading zero when disconnected from the circuit.
- Record voltage and specific gravity of each cell when making monthly check. Also record pilot cell temperature and correct specific gravity readings for observed temperature. Correct specific gravity readings by adding or subtracting 0.001 for each 3 F above or below 77 F respectively. If readings indicate that all cells are low, the battery is not receiving sufficient charge. If individual cells are low, an equalizing charge should be given.
- When giving an equalizing charge, gradually raise charging voltage to 2.33 volts per cell. Continue to float at this voltage until no increase is observed in pilot cell specific gravity for 24 hours after battery-charging current has tapered to a constant value. After the equalizing charge, record specific gravity of each cell.
- To determine whether the battery will deliver rated capacity, give it a discharge test. Test is given by first fully charging the battery and then discharging it at the 8-hour discharge rate. Test should be discontinued at the end of 4 hours to provide reserve should an emergency occur during the test. Record individual cell voltages while battery is on discharge at end of test period. All cells should read 1.92 volts or higher. If one or more cells read below this value, it indicates weakness and battery replacement should be considered.
- Records that are maintained monthly—from the initial charge throughout the life of the battery—should be filed. Comparison of records indicates if battery is being properly charged and maintained. Records also indicate whether maintenance checks should be made more or less frequently and will help in specifying replacement batteries when the time comes. ♦♦

In brief . . . .

Purdue industrial waste conference

Design data for industrial waste treatment

W. T. Laffey, Assistant Sanitary Engineer, Hercules Powder Company.

"Treatment of soluble organic wastes still offers the greatest challenge and the most interest because of the myriad combinations of wastes possible and, with the exception of soluble inorganic salts, it can encompass all of the other categories previously discussed. Although the primary purpose for biological treatment is a reduction in B.O.D., the effects on the receiving stream of taste, odor, color, or toxicity must be considered. With so many possible treatment methods available for organic stabilization, the number of combinations may approach the number of theoretical combinations of incoming wastes.

"We always start with a completely open mind and will consider lagooning, chlorination, ground percolation, trans-evaporation, submerged combustion, anaerobic digestion, high- or low-rate filters, activated sludge, and other methods in any combination or sequence that will provide the required degree of treatment.

"The first step, of course, involves complete analysis of the waste. In addition to the 5-day B.O.D. determination, other B.O.D. values should be obtained so that "k" and "L" values can be calculated. Organisms should be acclimatized to the waste for use in Warburg respirometer studies for toxicity and bacteriostatic data. With this information, and knowing local plant conditions, then many methods of treatment can be eliminated.

"By local plant conditions, I have in mind the nature of the process operations, the area available, the type of soil, the proximity to residential communities, power costs, available dilution water, etc. Some obvious examples of conditions ruling out some of these processes might be the presence of sandy soil for lagoons, the presence of clay soil for percolation and, of course, large volumes of weak waste would rule out submerged combustion or anaerobic digestion."

Establishing industrial waste ordinances

Dean M. Taylor, Sanitary Engineer, City of Cincinnati.

"A recent Public Health Service report stated that there were 11,811 municipalities having sewer systems, with about 56 percent having sewage treatment plants, most of which were receiving industrial wastes to some extent. A survey by the National Association of Manufacturers of more than 3000 industries indicated that 69 percent of the industries discharged all or a part of their wastes into municipal sewage works. These facts should help to convince us that industries and municipalities have a common problem in waste disposal.

"Waste disposal regulations are in force throughout the country. Although they vary considerably from state to state, they are becoming more severe with time. Enforcement is not always strict, but it seems evident that future action will be more so. Consequently, industries and municipalities must face the problems of installing proper waste disposal facilities.

"Industry naturally wishes to dispose of wastes at the lowest possible cost. This can usually be done by discharge to the municipal waste disposal system. Most industries in incorporated areas feel that it is the responsibility of municipal government to dispose of their water-carried wastes. Most municipalities are willing to accept this responsibility, provided the industrial wastes are acceptable for discharge to the municipal sewage disposal facilities. When the quantities of industrial wastes are much greater than those of domestic sewage, there are usually problems of jurisdiction and cost but these problems can be solved with equity.

"Every industry has the option of treating its own wastes and discharging them to public water courses. It then becomes the duty of water pollution control agencies to determine whether or not the effluents meet accepted pollution standards."

Vibrating screens in industrial waste water treatment

W. P. Stilz, Engineer-in-Charge, Vibrating Screens, Link-Belt Company.

"The vibrating screen has many advantages over the rotary in the handling of industrial waste water. Some of these advantages are:

"1) A vibrating screen is more compact, and when furnished complete with a steel tank it is a self-contained unit. The steel tank reduces to a minimum the amount of concrete work required.

"2) The vibrating screen requires less horsepower for operation.

"3) Spray water is not normally needed to wash particles from the screen cloth.

"4) Screen cloth required to resurface a vibrating screen is less than one-third the amount needed for a revolving screen, and much easier to install.

"5) The initial cost of a vibrating screen is lower in most cases.

"6) The vibrating screen produces dryer tailings to its motion. . . .

"Vibrating screens are used in a great variety of industries to handle waste water problems. Steel mills, canning plants, citrus concentrate plants, woolen mills, pulp and paper mills, sugar beet processing plants, and many others are among the industries using vibrating screens on waste water."

Location of wet-process industries

Truman H. Safford, Charles T. Main, Inc.

"Usual general requirements for industrial water supply specify that it be virtually free of suspended matter and turbidity, low in color and hardness, free of objectionable tastes and odors, and low in iron. Specific industries have particular additional requirements. For example, modern high-pressure boilers, 600 F or higher, require a water which will not deposit scale-forming substances, will not produce foaming, and will be noncorrosive to the metal in the boilers.

"Formerly the quality of the water in its natural state was much more important and many of our older industries were located where a lake or stream provided water suitable for processing without treatment. But present-day industrial water requirements are so rigorous that few natural surface waters are good enough to be used without treatment. Thus, in evaluating a surface supply, the question is whether it is of such quality that a water satisfactory in quality can be obtained economically, considering both plant investment and operating costs. . . .

"Coming back to the disposal problem there are advantages to owning land on both sides of a river. Certainly a "beach head" is highly desirable, since frequently it is important to lay a pipe across the width of the stream to diffuse the discharge and prevent stratification along the bank where the plant is located. It may also be desirable to have ownership upstream and downstream for a distance to control the type of manufacturing in the immediate vicinity, or to prevent hostile nuisance developments. In connection with the cost of land, once acquired, it is frequently possible to either use it, in the case of a pulp mill as part of a planned forestry program or, for

(continues on page 40)

new products

. . . just circle key numbers on READ-N-CIRCLE card on pages 49 or 50

700-Repair steel tanks without welding

Method for making repairs to metal tanks without welding is now available. Eliminates hazards and difficulties in making welded repairs to metal tanks and pipes. Method uses glass cloth and a newly developed filled epoxy resin material called Sonite. Sonite has great chemical stability and good adhesion to metals. It is oilproof and waterproof, resists acids and alkalies, and will withstand temperatures to 200 F.

To make a patch, the hole and surrounding areas are first cleaned down to bare, firm metal. When metal is dry, primer is mixed and painted onto the patching area and allowed to get tacky-hard. Glass cloth patch is then placed in position and pressed into the prime coat. Sonite is then painted over the glass cloth thoroughly so that no holes are evident.

Second patch is next applied over the first, and a second coat of Sonite is applied. Two glass cloth layers will do for holes in small tanks or pipes. Three or four layers are recommended for large tanks, or for use with acids or alkalies. Patch will harden. Tank or pipe then can be used in 18 hours at room temperature. External heat must be applied if hardening is to take place properly in cold weather.

Patching method eliminates hazards where flammable materials are being handled and where complete evacuation of flammable materials is necessary before repairs can be made. SMOOTH-ON MANUFACTURING COMPANY.

701-Hydraulic fluid is fire resistant

Economic, new fire-resistant fluid snuffs out fire. Fluid is a special formulation of water, petroleum hydraulic oil, and emulsifying agents. Fluid eliminates possibility of combustion by releasing its water content as a protective steam blanket to quench fire. In combustion tests, a stainless steel tube was heated to 1300 F. Ten mm of test fluid were poured on the tube over a period of approximately one minute. Under these conditions, there was no continuous burning of the emulsion. Hydraulic oil continues to function properly even if emulsified water is dissipated for any reason.

Irus 902 is noncorrosive on ferrous and most nonferrous metals. It is compatible with normal system components and has high film strength to provide antiwear and antiscuff protection for close-fitting machine parts. Fluid is colored bright yellow for instant recognition and to help locate leaks. In addition, fluid will not affect packing, seals, or hoses. SHELL OIL COMPANY.

702-Single-wheel power unit spots cars

Single-wheel, gasoline-powered unit spots railroad cars, yet weighs only 550 pounds. Air-cooled, single cylinder, two-stroke motor delivers continuous output of 6 horsepower.

Car shunter traverses rough ground. Climbs easily over rails, switches, and ties without damage. Unit engine has three-speed arrangement that pushes a loaded 65-ton railroad car at normal walking speed. Controls may be pivoted sideways to give operator full forward visibility. Car shunters can move loaded railroad cars up to 100-tons total weight.

Three-speed gear is contained in the box-type disc of the rubber-tired driving wheel. Drive is from the motor through a clutch coupling. Motor and internal rotating parts of the driving gear are positively lubricated by oil added to the gasoline.

Accessories (such as snowplows) can be easily attached. RAILROAD CAR SHUNTER CORP. OF AMERICA.

(more new products on page 34)

"Look Into" the latest complete data on

FUSES

FOR EVERY PURPOSE

To help you solve confusing fuse problems, Economy Fuse & Mfg. Co. has just issued a convenient, pocket-size folder that tells you exactly the right fuse for practically any purpose. This handy folder illustrates and describes all the latest fuse developments and lists capacities, sizes, prices, etc. Electrical contractors, and commercial, industrial or domestic fuse users, can obtain copies from their electrical dealer or wholesaler. "For Fuse Economy Use Economy Fuses."

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12251P

Circle 108 on READ-N-CIRCLE card for more data

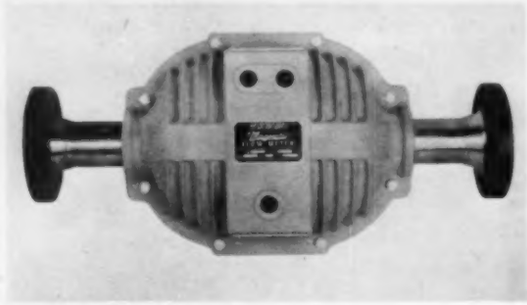
new products

. . . starts on page 33

703-Magnetic meter measures liquid flow

Magnetic flowmeter measures liquid flow with overall accuracy of ± 1 percent. Features advantages of no restriction to flow, linear readings, performance unaffected by pressure, viscosity, density, or changes in conductivity of flowing liquid.

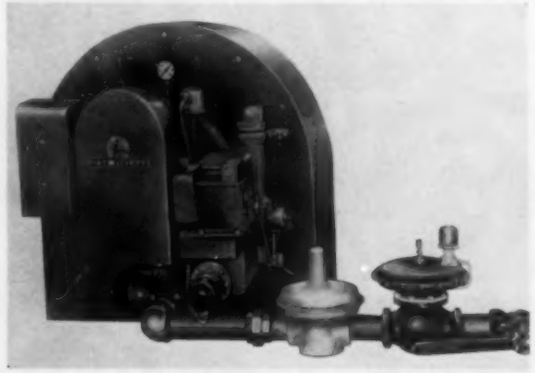
When conductive liquid passes through nonmagnetic flow tube, alternating voltage is set up between elec-



trodes. Voltage varies linearly in proportion to rate of flow. Lead wires from electrodes transmit this voltage output to recorder, which produces a chart record in appropriate flow units. Meter is now available in 1-inch size to handle full-scale flows of 10 gpm or greater. The Foxboro Company.

704-Gas-oil burners for every use

Combination gas-oil burners for industrial applications now have integral air register. Burner section and air register, shipped as separate units, may be quickly and easily bolted together on the job. Oil burner



ratings are from 9 to 125 gph. Ring-type gas burner may be used with either natural or manufactured gas in capacities from 1,650,000 to 18,750,000 Btu/hr input. Flexibility is proven by the rapid changeover ability. Changeover from one fuel to another is accomplished by operating a selector switch. No mechanical changes are necessary. Electronic combustion controls automatically shut down the burner in case abnormal conditions arise. Automatic magnetic starter switch is

provided for oil burner motor. IRON FIREMAN MANUFACTURING CO.

705-Layout tape reduces drafting time

Pressure-sensitive, transparent layout tape reduces detail drafting time. Symbols printed on the type remain permanently clear and sharp, protected both above and below by layers of tough, transparent acetate. Tape

is ready for use immediately upon being stripped from the roll. Printing is easy to read and reproduces clearly. LABELON TAPE CO., INC.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 49 or 50.

706-Electric hammer eases maintenance

Lightweight electric impact hammer weighs only 12 lbs, 13 oz—yet delivers 1900 blows per minute. Solid, hard-hitting blows are assured by exclusive spring-floated piston. Design prevents leakage and power loss,

which often occurs with air-cushioned piston. Hammer, equipped with star drill, will drill holes in concrete up to 1⅛-inch diameter. Unit is available in standard kit form, with a choice of three accessory kits. In-

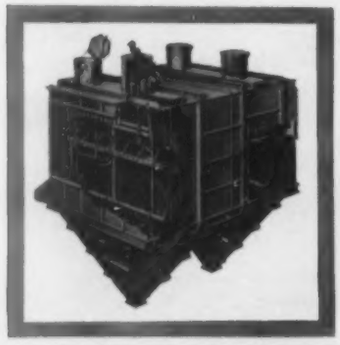
World's largest fleet of coal cars
62,000 coal cars, with 8,000 more on order, insure dependable deliveries from mines on the C&O
Chesapeake and Ohio Railway
WORLD'S LARGEST CARRIER OF BITUMINOUS COAL
For dependable deliveries of top quality coals, contact coal producers on the C&O. And if you need help in meeting your own particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Circle 110 on READ-N-CIRCLE card for more data

Buell "LR" Fly Ash Collectors GUARANTEED for TOP EFFICIENCY

Buell Cyclone Collectors also deliver extra efficiency, due to exclusive shave-off design which harnesses backflow and puts it to work!

The Buell Guarantee of Efficiency which goes with every installation of an "LR" Fly Ash Collector is based on many years of successful field experience. The simplicity of design and proved efficiency of performance makes the "LR" ideal for low and high pressure boiler operations up to 2000 BHP with either natural or mechanical draft.



Buell "SF" Electric Precipitators with exclusive Spiralectrodes and Continuous Cycle Rapping have established brand new concepts in dust collection efficiency.

FREE BOOKLET!
"The Collection and Recovery of Industrial Dusts." Write to: Buell Engineering Company, Dept. 90-H 70 Pine Street, New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

Circle 100 on READ-N-CIRCLE card for more data

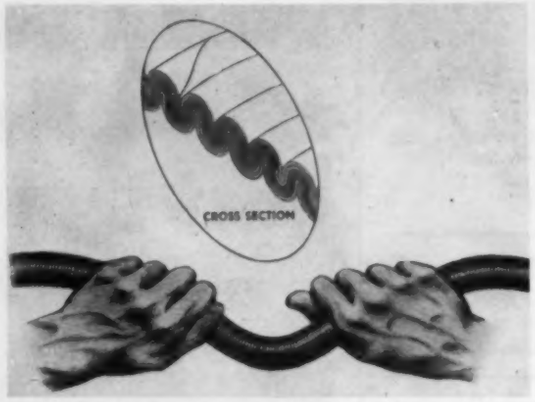
new products

. . . starts on page 33

dividual accessory items can be purchased as desired. Complete list of accessories make this electric hammer a true all-purpose tool. INGERSOLL-RAND CO.

707-Pliable tubing saves installation time

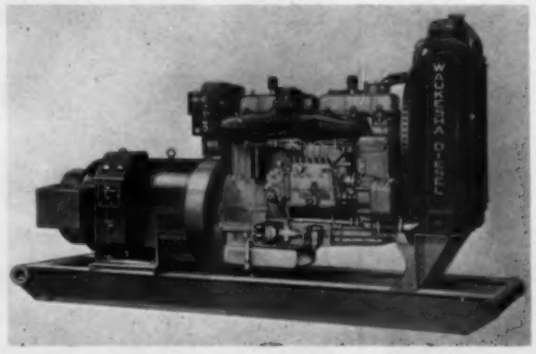
Pliable tubing having high wall strength, watertightness, and sharp bending radii substantially reduces installation time. Proves ideal for bearing in concrete, ceilings, and floors. Can be cut with a hacksaw or knife, can be bent by hand, and fits all standard connectors. Tubing can be made of copper, brass, aluminum, steel,



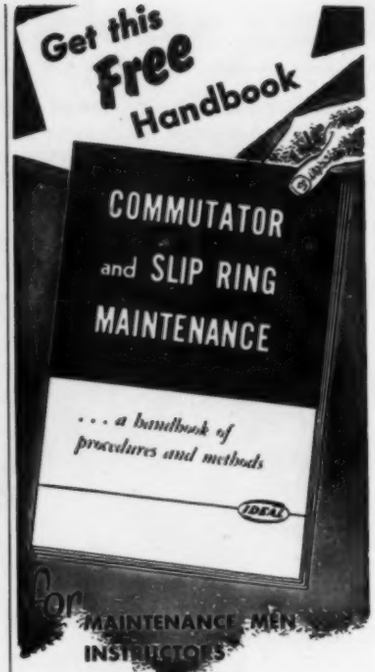
asbestos, fiber, paper, and combinations of these materials. Can be used for lubricating, coolant and other noncorrosive liquid lines, hot and cold air ducts, and pipe insulation. Sizes range from ⅜-inch to 2-inch id. THE FLEXAUST COMPANY.

708-Power package gives plenty of power

Heavy-duty engine-generator sets are now available in capacities from 50 to 600 kw. Engine-generator sets



can be supplied for gas, gasoline, or diesel fuel. Accurately balanced engine and generator combinations result in smooth, steady power flow for continuous, intermittent, and standby duty. The Waukesha 148-diesel is available as standard diesel with standard or



THE methods and procedures described were developed by recognized, practicing maintenance authorities. They have been proven by conclusive evidence over many years in hundreds of operations. A concise guide, this 39-page handbook tells the practical operating man everything he needs to know about:

- Commutator and slip ring troubles and how to correct them.
- Brush maintenance and operating procedure.
- General maintenance procedure.

Dozens of illustrations show the operations described. Condensed data on IDEAL commutator and slip ring products is included.
Even if you do not have a regular maintenance training program, your people responsible for motor and generator maintenance need, and will do a better job, with the help of this handbook.

NOTE: This offer is limited to those in plant and other industrial operations. We reserve right to limit quantities furnished. Offer may be withdrawn at any time.

IDEAL INDUSTRIES, Inc. IDEAL
4023 Park Avenue, Sycamore, Illinois

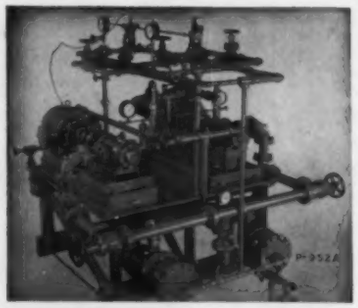
Please send _____ copies of your free handbook on commutator and slip ring maintenance.

Name_____
Title_____
Company_____
Address_____
City_____ Zone_____ State_____

Circle 121 on READ-N-CIRCLE card

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER . .



P-952-A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, pre-heat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40—very interesting and informative.

OIL BURNERS and GAS BURNERS for Industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1350 E. Seagley Avenue, Philadelphia 34, Pa.
Southwestern Division:
2512 South Boulevard, Houston 6, Texas

Circle 137 on READ-N-CIRCLE card

counterbalanced crankshaft, or as turbo-supercharged diesel with counterbalanced crankshaft. WAUKESHA MOTOR COMPANY.

709-Glass line your steel smokestacks

New glass lining process for steel smokestacks now eliminates deterioration under corrosion through acid condensation. Glass coating at 5 oz/sq ft compares with conventional inside linings of up to 50 lb/sq ft. Glass lining may be provided for both inside and outside surfaces of smokestack. Corrosion free surfaces, inside and outside, give stack years of added life without maintenance and with lighter foundation costs. A. O. SMITH CORP.

710-Reflector aids mercury lighting

First floodlight designed specifically for color-improved mercury vapor lamps provides broad lighting pattern. Units give area coverage without overlapping and without hot spots or shadows. Lateral light spread is 130 degrees and vertical is 90 degrees. Installations

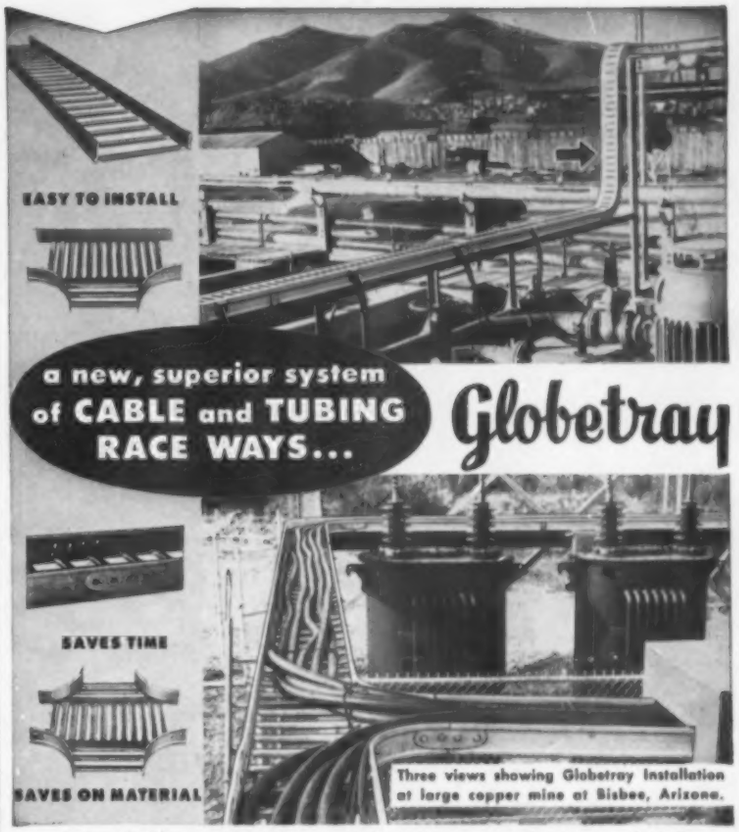
require 47 percent less power. Units operate on 220 or 440 volts. Cast aluminum alloy enclosure gives rapid heat dissipation and uses a heat-resistant glass lens. Drastically reduces relamping maintenance because lamp life is six times that of an incandescent floodlight. Completely sealed to insure long reflector life. WILSON ELECTRIC COMPANY.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 49 or 50.

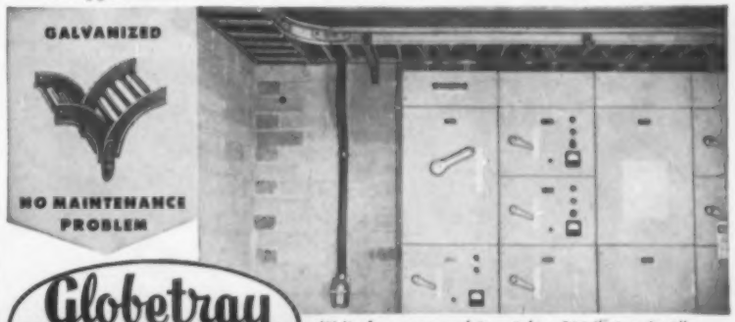
711-Control with electric governor

Extremely rapid, highly accurate speed regulation is now possible with new electric governor. Within 0.015 seconds after electric load change, instantaneous electric circuit plus simple, high-force hydraulic system act together to initiate throttle change. Performance data shows transient speed deviations of less than 1.5


EASY TO INSTALL
a new, superior system of CABLE and TUBING RACE WAYS...
Globetray
SAVES TIME
SAVES ON MATERIAL
Three views showing Globetray installation at large copper mine at Bisbee, Arizona.

A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point—insides and bottom always smooth—all sections punched for easy installation—perfect fit at all times. Neat, clean and uniform in appearance.



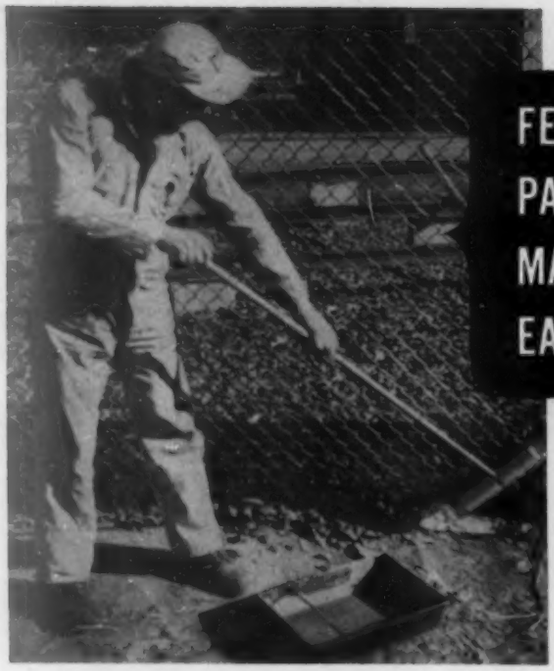
Globetray
THE GLOBE COMPANY

Write for new complete catalog. Distributors in all principal cities. Contact the Grip-Strut distributor under "Conduits" in the classified telephone directory.

Manufacturers Since 1914 **The GLOBE Company**

4036 S. PRINCETON AVE. • CHICAGO 9, ILL.

Circle 105 on READ-N-CIRCLE card for more data



FENCE PAINTING MADE EASY

Subox makes fence painting easy and economical.

Subox paints are so simple and quick to apply that you can put them on by spray or roller coating methods — but for the fastest and most satisfactory results use an ordinary floor broom!

Subox paints are the only paints in America made with *suboxide of lead* — one of the most effective rust-inhibitive and anti-corrosive agents known. In addition, being a heavy colloidal pigment, it prevents spattering when applied to wire mesh. Subox goes on smoothly, evenly, thoroughly and adheres closely.

Next time use Subox. It costs no more than other paints and endures for many years. Comes in a wide variety of decorative colors.

Detailed instructions for easy, economical fence painting are contained in the booklet, *"Simplified Fence Painting"*. Send for a copy.

Subox Inc.

Established 1924

9 Fairmount Plant, Hackensack, N. J.

See Catalogues in Sweet's Industrial and Engineering Files.

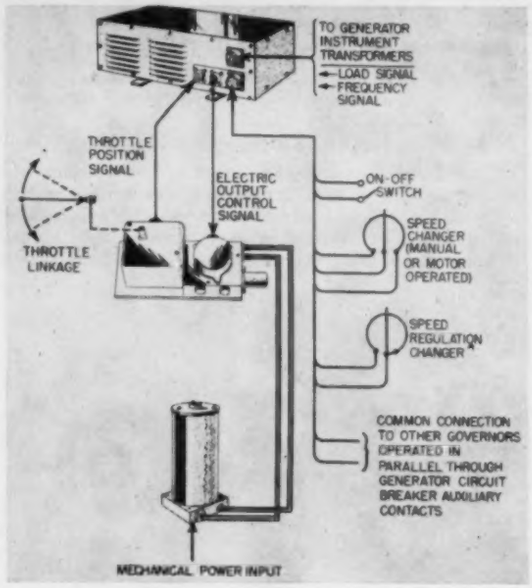
Circle 120 on READ-N-CIRCLE card for more data

new products

. . . starts on page 33

percent for full-load change and recovery to steady-state in less than one second. Under steady-state conditions, electric governor will control generator output frequency within ± 0.25 percent of base frequency.

Electric governor also controls operation of two or


TO GENERATOR INSTRUMENT TRANSFORMERS
LOAD SIGNAL
FREQUENCY SIGNAL
THROTTLE POSITION SIGNAL
ELECTRIC OUTPUT CONTROL SIGNAL
ON-OFF SWITCH
SPEED CHANGER (MANUAL OR MOTOR OPERATED)
THROTTLE LINKAGE
SPEED REGULATION CHANGER
COMMON CONNECTION TO OTHER GOVERNORS OPERATED IN PARALLEL THROUGH GENERATOR CIRCUIT BREAKER AUXILIARY CONTACTS
MECHANICAL POWER INPUT

more sets, with all units adjusted for zero speed regulation. Governor units have been designed for 50/60-cycle or 400-cycle applications. WESTINGHOUSE ELECTRIC CORPORATION.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on pages 49 or 50.

712-Compression sleeves make tight connections

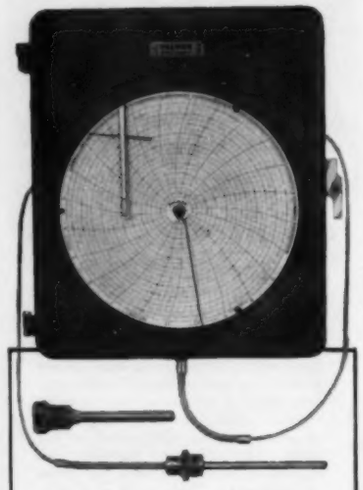
Compression sleeve connectors made of highly conductive aluminum alloy give high pullout strength.

Sleeves are made in ⅝-inch od and are designed to make use of currently available ⅝-inch dies and tools. Seventeen sizes in the ⅝-inch line accommodate all

PALMER

MERCURY ACTUATED recorders

Into this modern Mercury Actuated Recorder has gone all the skill of Palmer master craftsmen.



Readings are clearer, smoother and more precise than ever thought possible. In fact readings are so amazingly improved that maintenance is never needed under normal uses.

Recording Thermometers feature twelve inch die-cast aluminum case with black wrinkle or white satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 to 1000°F. or Equivalent in °C.

Send for Bulletin No. 45

Consult your Classified Directory

PALMER

THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording and Dial Thermometers

Cincinnati 12, O.

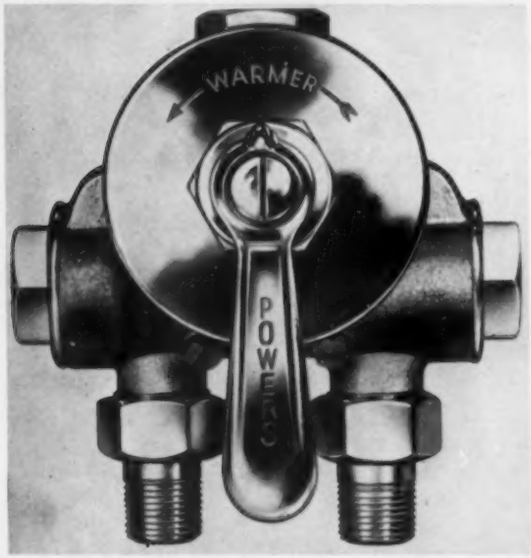
Circle 113 on READ-N-CIRCLE card

popular combinations of aluminum, ACSR, and copper conductors from No. 8 to 1/0 Awg.

Fadeproof standard color-coded plastic caps identify cable sizes. Center stop is provided in compression sleeve to prevent contact of dissimilar metal cables. ANDERSON ELECTRIC MFG. CO.

713-Valve makes cold water hot

Unique mixing valve automatically mixes cold water and steam to provide hot water at any desired temperature. Control handle regulates hot water temperature at any temperature up to 200 F, regardless of supply line pressure changes. Check valves prevent inter-

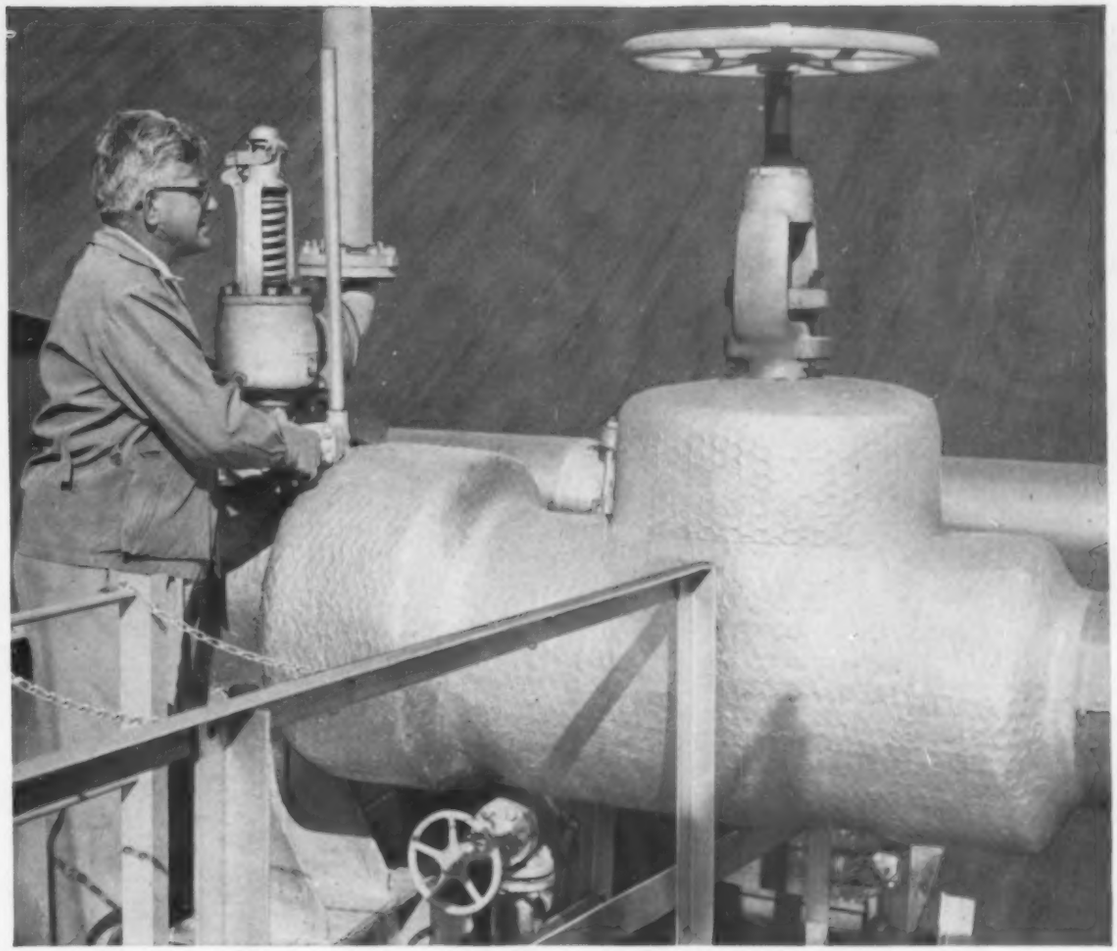


change of steam and cold water when not in use. Valve is available in ½- and ¼-inch sizes. Valve compensates for pressure variations in supply lines caused by other outlets on the line. THE POWERS REGULATOR COMPANY.

714-Higher ratings with butyl molded case

Unusually high mechanical and thermal ratings are achieved in butyl-molded instrument transformers. Available in all standard ASA current ratings from 15:5 to 800:5 amperes. Thermal rating is 100 percent

of rated current with 55 C ambient and 133 percent of rated current with 30 C ambient. Butyl molding makes this 15-kv current transformer weigh only 47 pounds. GENERAL ELECTRIC COMPANY.



This Crane valve has 20-year cost-free record on 400 psi. steam at 750° F.

Twenty years on this high-temperature steam boiler outlet service with never a wrench on it—that's valve performance in any man's language.

This Crane 8-inch No. 179U cast steel stop-check valve has racked up just such a record at Fort Bend Utilities Co., Sugar Land, Texas, and is working as smoothly today as it did two decades ago.

The Fort Bend Utilities plant—a subsidiary of the neighboring Imperial Sugar Co.—finds this Crane stop-check an important aid to boiler efficiency.

Its high-lift disc permits maximum flow-through, with minimum pressure drop under varying load conditions. Seating is instantaneous on back flow.

On manual closure, about once yearly for boiler servicing, the valve has never failed to respond smoothly and seat tightly.

To valve users experienced with Crane quality, this performance record is not so unusual. Thousands of Crane stop-checks throughout industry are giving similarly outstanding service.

The superior materials, the top-flight engineering and construction designed into all Crane valves give them service capacity and durability second to none.

Get these advantages next time you order valves: specify Crane and be *certain* of the valve service you want. Consult your local Crane Representative or write to address below.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

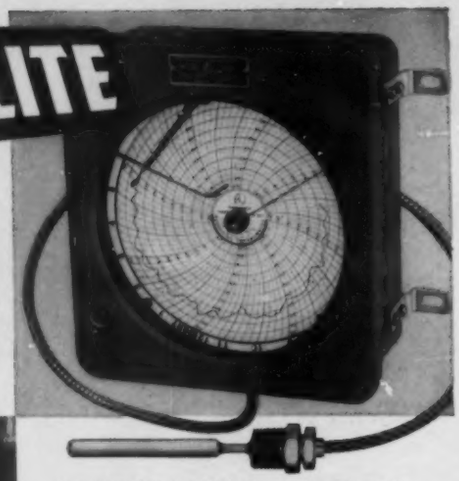
Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

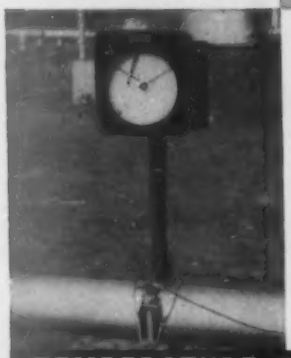
Circle 131 on READ-N-CIRCLE card for more data

AUTO-LITE

...for TEMPERATURE RECORDING...

One of the many uses for Auto-Lite Recorders is the application shown below . . . a natural gas field meter run.





Auto-Lite Model "1000" Temperature Recorder has 6" chart. Various standard ranges from minus 40° F to plus 550° F. Available for wall mounting, portable or portable self contained use. Electric or mechanical chart drive. Choice of 24-hr. or 7-day cycle. Capillary tubing permits remote reading. Priced as low as $49.50. Manufactured to customers' specifications. Send for latest Catalog describing many types of Auto-Lite Recorders and indicators.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS & INDICATORS

Circle 115 on READ-N-CIRCLE card for more data

16 NEFF & FRY BINS IN THIS GROUP

These bins are used for handling silica sand. They range in size from 18′ dia. x 52½′ high to 12′ x 12½′. Machinery for screening and grading the sand is mounted directly on the bins without extra supports, proving the load-bearing strength of Neff & Fry construction.

Thousands of Neff & Fry Bins are being used for handling and storing nearly a hundred different kinds of bulk materials, including grain, coal, seeds, minerals, chemicals, clay, wood chips, etc.

Before you decide on storage bins, ask us for complete information. Read our folder, "Bins With the Strength of Pillars." Our bins will likely save you money on first cost, and certainly on maintenance.

SUPER-CONCRETE STAVE STORAGE BINS

NOT EXPORTED EXCEPT TO CANADA AND MEXICO.

The Neff & Fry Co. • 120 Elm St. • Camden, Ohio

Circle 122 on READ-N-CIRCLE card for more data

Purdue waste conference

. . . starts on page 32

other types of industry, rent the land to others for cultivation."

Closed-system use of industrial water

C. J. Lewis, National Gypsum Company.

"There are a number of sound reasons why the exploration of the "closed system" should receive a greater share of our attention. In the first place, there are some areas, and will probably be many more, wherein the treatment of industrial waste effluents by a "closed system" process will be a must, because of the limited water supply available. Secondly, those industries discharging relatively small amounts of treated effluent directly to public sewage treatment works may find it economically advantageous to install the "closed system." This would be particularly true where the cost of purchased water also involves a proportionate cost for discharge to public sewers. It is not inconceivable that in some cases the cost of treated effluent for re-use will be less than the cost of purchased water.

"In addition, there is always the possibility that the effluent from the waste treatment may have desirable properties when re-cycled into the industrial process. For example, many effluents after treatment are practically lacking in dissolved oxygen, which condition should render such effluent less corrosive when compared with fresh water containing its full component of dissolved oxygen. . . .

"It is not my purpose at this time to suggest specific procedures for developing waste treatment processes to the point where they can become "closed systems." However, I call to your attention the new horizons such development offers. At present, we evaluate treated effluents in terms of their effect on the receiving surface waters, and use as our unit of measure such factors as biochemical oxygen demand, turbidity, toxicity, pH, etc. But, if the source of a water supply be from wells and it were desired to close this system by returning the effluent to the water table, then other effluent properties must then be taken into account. The problem now pertains more to subterranean chemistry and biology rather than to surface water, and a new field for exploration is therefore opened . . . .

"I repeat that the "closed system" should be given more attention in the development of industrial waste treatment processes; after all, industrial effluents are mostly water and it is quite possible that the time will come when usable water from the treatment of of the industrial effluent will be the most valuable by-product from the treatment process." ♦♦

HOW YOU SAVE...

...getting drier Compressed Air

● Save the cost of cooling water and you save the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

Extra, for no cost, you get drier compressed gas or air for your process. You get better operation and lower costs in the use of all air-operated instruments, machines, or paint sprays. You save expense for piping, pumping, water treatment and disposal. You get the use of badly needed water elsewhere in your plant.

Niagara Aero After Cooler cools compressed air or gas (evaporatively) below the temperature of surrounding atmosphere, with no further condensation in your air lines.

Write for complete information; ask for Bulletin No. 130, or contact nearest Niagara Engineer if you have any problem involving the industrial use of air. Address Dept. IP

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers
in Principal Cities of U. S. and Canada

Circle 107 on READ-N-CIRCLE card

new bulletins

. . . just circle key numbers on READ-N-CIRCLE card on pages 49 or 50

400-Boiler maintenance tool manual

Boiler tubes need cleaning, replacement? Bulletin 59 describes the entire line of precision-made boiler tube maintenance tools. Includes complete data on tube cleaners, cutters, and expanders. Lists sizes, weights, and operating speed of each unit. Includes description of complete line of accessories to make your boiler maintenance chores easy. Describes boiler tube cleaners for tube sizes from ½-inch to 4-inch id. Eight pages. AIRETOOL MANUFACTURING COMPANY.

401-Turbogenerators from A to Z

Turbogenerator construction, operation, and installation are thoroughly discussed in this bulletin. Discusses condensing, condensing extraction, noncondensing, noncondensing extraction, and mixed-pressure extraction units with advantages and limitations of each. Cross section of typical turbine gives excellent understanding of all turbine components. Includes section on lubrication with recommendations for correct piping and accessories. Also shows cross section of typical generator with bearing, exciter, rotor, and shaft details. This excellent three-color bulletin is a recommended addition to the library of all power services engineers. Thirty-six pages. WORTHINGTON CORPORATION.

402-Facts about industrial insulation

New additions to the line now give full coverage in industrial insulation products, as covered in Bulletin A-400. Describes new, accurately molded product made from inorganic silicas that will withstand temperatures up to 1600 F. Insulation shows no deterioration or effect on thermal conductivity after exposure to high moisture. It is furnished as pipe covering in convenient three-foot sections, flat, curved, or segmental blocks. High thermal efficiency and high structural strength enable it to be used in single-layer applications or as a base layer with 85-percent magnesia. Four pages. THE EAGLE-PICHER COMPANY.

403-All-purpose electric gearmotor bulletin

Latest design improvements in electric gear motors in capacities from 1/3 to 30 horsepower are described in Bulletin F-1880. Cross section illustrations show salient construction features. Single-, double-, and triple-reduction gearmotors are included, with operating characteristics of each. Includes lubricating details, and describes totally enclosed and explosion-proof models. Sixteen pages. U. S. ELECTRICAL MOTORS INC.

404-All-purpose thermocouple manual

Will thermocouples answer your temperature recording problems? Thermocouple advantages, temperature and pressure ranges, and construction materials are described in Catalog 1556. Lists information on thermocouple sealing glands. Sealing gland construction gives positive sealing at pressures from full vacuum up to 20,000 psi. Cutaway sections show all sealing gland components. Complete specifications are included for all thermocouple materials with recommended installation practices. Time-of-response chart is given for standard thermocouples through temperature range from 0 to 100 C. Twenty-eight pages. CONAX CORPORATION.

405-Better drafting with tapes

How to get better visual impressions from flow charts, graphs, and office and plant layouts is described in Bulletin 4C-50 3-56. Explains how pressure-sensitive tapes and templates minimize drafting time and retain better visual interpretation. Commonly recognized lines, shapes, bars, and symbols are preprinted on tapes with adhesive backing. Completed charts and layouts may be reproduced by any standard method. Tapes contain descriptive symbols for structural components, material conveyors, and all commonly used equipment. Twenty pages. CHART-PAK, INC.

406-Pumping and sewage treatment manual

Get recent engineering data and specifications on sewage pumps and treating equipment. Manual 1114 lists seven pump types with comments on advantages of each type. Includes selection chart for determining capacities, pressures, and volumes of each pump type. Gives typical cross section of piping arrangement for industrial and sewage disposal. Lists installation diagrams for bilge or sump pumps showing maximum lift and capacities at various speeds. Gives thorough treatment of pumping and piping problems for all phases of sewage treatment and disposal. Sixteen pages. YEOMANS BROTHERS COMPANY.

407-Preload washers control setting stress

Preload indicating washers that control setting stress to within ±10 percent are described in Bulletin 2165. Washers consist of two concentric steel rings sandwiched between two close-tolerance washers. Inner concentric ring is compressed as bolt is tightened. When inner ring is compressed to point where outer ring binds against adjacent washers, desired preload has been automatically induced in bolt. Complete line of washers is available for standard bolts ranging from No. 10 through 1½-inch dia. Washers for higher stress levels can be obtained on request. Twelve pages. STANDARD PRESSED STEEL CO.

408-Propeller fan data

Revised specifications, performance data, and dimensional drawings on entire line of propeller fans are contained in Bulletin A-109B. Includes latest data on reversible, low-noise, and utility fans, with description of heating and cooling units. Includes charts listing performance of each unit with installation diagrams showing proper piping and control location. An excellent manual for heating, cooling, or ventilating problems. Forty pages. HARTZELL PROPELLER FAN CO.

409-All-weather, single-phase motors

Bulletin 470-A describes new 10- and 15-horsepower all-weather, high-torque, capacitor-start, single-phase outdoor electric motors. Discusses protective features that prevent entrance of moisture. Lists NEMA frame numbers available and includes installation recommendations. Four pages. ROBBINS & MYERS, INC.

410-Centrifugal refrigeration engineering data

Basic engineering data on new hermetic centrifugal refrigerating machine is presented in Catalog 19C-100. Compact, lightweight centrifugal cooling unit features pushbutton operation and low installation costs. Units are available from 90- to 350-ton models. Includes easy-to-read tables for selecting best combination of compressor, cooler, and condenser. Includes installation dimensions plus list of essential components weights. Gives schematic electric control diagram for ease in planning wiring. Twenty pages. CARRIER CORPORATION.

411-Quick selection charts for V-belts

Quick, easy selection of V-belt drives is now possible with Bulletin 20P50. Provides selection tables for A, B, C, and D section variable-speed drives. Lists horsepower rating tables for all belt sections, gives design features and drive principles. Includes installation possibilities. Lists formulas for calculating correct V-belt for your installation. Includes accessories such as sliding motor bases and adjustable sheaves with from 1 to 12 grooves. Recommended for all power services engineers. Forty-four pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

412-General-purpose pump manual

Specific engineering data on more than 50 pumps in the complete line are given in Form 7223-B. Describes pumps with capacities from 5 to 2800 gpm, with pressures from 10 to 525 feet total head. Cutaway view shows salient design features. Includes performance data on all pump types (including self-priming, end and

Is Space an Important Factor?

Then Use This Distinguished Line of Close-Coupled Pumps

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STEAMLINED! to heat water fast, at low cost

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new bulletins

. . . starts on page 41

side suctions) with electric, diesel, or gasoline-engine drives. Includes a complete list of accessories with recommendations for their application. Twenty pages. INGERSOLL-RAND CO.

413-Need directional control valves?

Three- and four-way directional control valves for fluid power systems up to 3000 psi are described in Bulletin 80300. Includes valve body details and the functions of standard and special plungers. Offers wide choice of plungers and flanges for mechanical, manual, hydraulic, and solenoid-pilot operation. Valves are available in sizes from ½- to 3-inch. Sixteen pages. THE OILGEAR COMPANY.

414-All about pneumatic pressure-ratio computer

New computer that measures compressor inlet and outlet pressures and simultaneously calculates pressure-ratio is described in Bulletin MSP-103B. Features wide range, flexibility, accuracy, and pneumatic signal transmission. Instrument indicates pressure-ratio and generates a proportional pneumatic signal for control. Available for static pressure ranges from 0 to 10 psia, and 0 to 400 psig. Four pages. HAGAN CORPORATION.

HOW TO GET COPIES

To get a free copy of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on pages 49 or 50.

415-Venturi tube cleans dust-laden air

Bulletin 920 describes new principle for wet collection of industrial dusts. Lists dimensions, weights, and capacities for all models in the line. Describes how venturi tube principle disperses fine particles of water into dust-laden air. Dust trapped in the water particles settles to tank bottom for automatic removal. Eight pages. PANGBORN CORPORATION.

416-Combination gas-oil burners

Pulsation-type oil-gas burner that incorporates high-efficiency nozzle mixing with burner-liner refractory is described in this bulletin. Operates with equal efficiency through the entire heat range, providing clean, economical heat with any oil or gas under all firing conditions. Burner will use any fuel from lightest distillate through No. 6 fuel oil or Bunker C, and high-pressure gas. Burners are available in six standard sizes from 72,000 Btu to 70,000,000 Btu. Four pages. RADIANT PRODUCTS COMPANY.

417-Comprehensive marine valve manual

Complete data on all the latest steel valves for a wide variety of marine applications are included in Catalog 256. Describes improved features such as streamlined bodies for low pressure drop, space and weight reduction, and improved gearing. Contains data on valves in all configurations from ¼- inch through 12-inch sizes. Also contains valve dimensions and weights for operating pressures up to 2500 psi. Thirty-two pages. EDWARD VALVES, INC., SUBSIDIARY OF ROCKWELL MANUFACTURING COMPANY.

418-Need ion exchange materials?

Bulletin 58 lists physical and chemical properties of the complete line of ion exchange materials. Includes curves giving expansion characteristics and pressure drop at various water temperatures. Describes regeneration, rinse requirements, bed depth, and operating capacity. Gives easy-to-understand discussion of principal water conditioning methods in use today. A recommended manual for all engineers concerned with water treatment. Twenty-eight pages. NATIONAL ALUMINATE CORPORATION.

419-Read about automatic coal scales

Operation, components, and auxiliary equipment for automatic, high-speed coal scales are described in Bulletin 0352A. Two units are available, with hourly capacities of 20 and 40 tons respectively. Bulletin describes feeding, weighing, and discharge cycles of the scale. Also discusses components such as belt feeder, weigh hopper, housing, and controls. Gives complete list of available accessories. Includes 31 photographs and drawings of typical installations. Sixteen pages. RICHARDSON SCALE CO.

420-Twenty-three grades of castables

Twenty-three different grades of castables, classified into five catagories, are discussed in Bulletin 38. Lists specific advantages of each grade, includes charts of characteristics, and illustrates typical applications. Lists recommendations for using each castable with setting time, comparative costs, and physical properties. Includes chemical composition and operating temperature limits. Four pages. PLIBRICO COMPANY.

421-Floors invulnerable to heavy loads

Steel floor plate that heavy loads can't damage is described in Bulletin AD-206. Material consists of an 11¾ inch square plate of hot-rolled steel designed to reinforce and protect concrete floor surfaces. Describes procedure to install flooring. Finished floor results in combination of 74-percent steel and 26-percent concrete. Plates—once in place—cannot work loose, weave, or rattle. Four pages. ACME STEEL COMPANY.

422-Coiled cords for everything

Catalog 556 contains information on complete line of retractile cords for hand and machine tools, hoists, trolley duct, and communications equipment. Includes more than 25 illustrations of many different uses for these springlike cords. Cords extend to approximately six times retracted length, and return to normal size when released. Lists cords in lengths to 25 feet and containing from 1 to 37 conductors. Twelve pages. KOILED KORDS, INC.

423-Complete data on nonshrink grout

Complete specifications and data on nonshrink grouting for heavy equipment, anchor bolts, building columns, and bridge seats are now available. Specifications give recommendations on storage, mixing, forming, placing, and finishing. Contains data on strengths, cold- and hot-weather precautions, finishing edges, and removal of leveling devices. THE MASTER BUILDERS CO.

spotlight on you . . . .

Ever fill out one of our READ-N-CIRCLE cards and wonder how many of these cards IP receives? Who sends in these cards? Who, in fact, reads INDUSTRY POWER?

We took time out this month to do some counting, and discovered that we had processed 10,331 cards during the last 12 months. On these 10,331 cards you asked for 51,741 pieces of literature from manufacturers. (Incidentally, IP received over 3500 letters from you during the same 12 months—but more of that in a later column.)

Going a step further, we analyzed two issues to see just where all these READ-N-CIRCLE cards come from. Here is what we found out about you.

(Next month we will tell you more about what you have told us about yourself in recent surveys. Look for *spotlight on you.*)

1) Size of firm of readers responding to January and February, 1956 issues

CAPITAL RATINGS		REQUESTS	PERCENT OF TOTAL
Over $1,000,000		1533	75.6%
Over $500,000		77	3.8%
Over $100,000		54	2.7%
Over $50,000		28	1.4%
Over $10,000		24	1.2%
Under $10,000		18	0.9%
TOTAL RATED		1734	85.6%
Foreign		10	0.5%
Listed, Not Rated		47	2.3%
Firms not normally assigned capital ratings		170	8.4%
Consulting Engineers	50	2.5%	
Government Engineers	74	3.6%	
Public Buildings	46	2.3%	
Total Not Rated		65	3.2%
GRAND TOTALS		2026	100.0%

2) Functional breakdown by job title of readers responding to January and February, 1956 issues

JOB FUNCTIONS	INDIVIDUALS REQUESTING MATERIAL	PERCENT OF TOTAL	TOTAL NUMBER OF REQUESTS
General Administrative Management: President, Other Corporate Officers, Owners, Partners, General Managers, etc.	88	4.4%	423
Plant Management: Plant Managers, Works Managers, Manufacturing Managers, General Superintendents, Superintendents, etc.	167	8.4%	649
Plant Department Heads: Supervisors, Foremen, Chief Electricians, etc.	205	10.1%	871
Engineering Management: Chief Engineers, Plant Engineers, Engineering Directors and Managers, etc.	436	21.5%	2081
Staff Engineers: Mechanical Engineers, Chemical Engineers, Electrical Engineers, Power Engineers, etc.	796	39.3%	4596
Consulting Engineers:	79	3.9%	530
Industrial Sales Engineers:	72	3.4%	382
Purchasing Agents:	21	1.0%	205
Educational: Engineering Instructors, Librarians, etc.	23	1.1%	198
Miscellaneous, Titles not given, etc.	139	6.9%	752
TOTALS	2026	100.0%	10,687

Would you like to receive INDUSTRY POWER regularly?

If you are not already receiving INDUSTRY POWER personally, fill in the information called for below. If you qualify as an engineer who manages power services, you will be added to our circulation list without payment of any formal subscription price.

To qualify for INDUSTRY POWER'S regular circulation list, you must have engineering responsibility for installation, operation, and/or maintenance of power services in your company. (Circulation is extended to consulting engineers responsible for power services.)

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Name _____

Title _____

Company _____

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Describe job function and responsibilties:

_____

_____

Number of persons employed in plant _____

Check off all categories that apply to you:

_____Manufacturing plant

_____Utility

_____Service industry or institution

_____Consulting or construction engineers

_____Engineering headquarters of multiplant firm

_____Government installation

_____Other _____

Equipment ratings:

Boilers: Number _____ Total Capacity: _____ lb /hr

Total connected electric load _____ kva

Total transformer capacity _____ kva

Total number electric motors _____ Total hp _____

Total number pumps _____ Total hp _____

Total number compressors _____ Total hp _____

Products manufactured _____

Signed _____

Date _____

basic bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 49 or 50

AIR CLEANING EQUIPMENT

500-Basics for precipitators

Five basic engineering requirements for a successful precipitator installation are discussed in Bulletin 104. Discusses positive control of gas flow, high, uniform electrode emission, continuous cycle rapping, simple construction, and trouble-free, high-voltage equipment. Lists nine time-tested steps to a successful installation. Twenty-four pages. BUELL ENGINEERING COMPANY.

501-Cleaner air with precipitators

How to clean air by electrostatic precipitation is described in detail in Bulletin B-1425. Includes illustrations and specifications describing installation, operation, and maintenance of Precipitron units. Describes salient features that permit unit operation to be controlled from outside location. Eight pages. WESTINGHOUSE ELECTRIC CORPORATION.

AIR CONDITIONING, HEATING, VENTILATING

502-Gas-fired heaters save space

Advantages of gas-fired commercial and industrial heating units are fully described in Catalog GN-56. Includes data on suspended gas unit heaters, both fan and blower types, in capacities from 25,000 to 250,000 Btu. Lists specifications, construction details, easy-to-read dimension drawings, and selection tables. Describes how suspended heaters save valuable floor space for process operations. Twenty-four pages. REZNOR MANUFACTURING COMPANY.

BOILERS AND BOILER ACCESSORIES

504-Need steam in a hurry?

The advantages of completely assembled fast steaming boilers are discussed in Bulletin 1220. Available in sizes to 500 hp and pressures to 250 psi. Includes engineering data. Four pages. ORR & SEMBOWER, INC.

508-Learn facts about boilers

Here's a factual down-to-earth discussion about all phases of specification, selection, and operation of steel fire-tube boilers. Bulletin 983 discusses flexibility, dependability, lower costs, and longer boiler life. Includes cost calculations showing how substantial savings can be made over a period of years. Gives a comprehensive discussion about maximum and nominal capacity. Twelve pages. KEWANEE BOILER DIVISION, AMERICAN STANDARD CORPORATION.

509-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC, based on total dissolved solids in boiler water. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of boiler installation. HENSZEY CO.

COMMUNICATIONS SYSTEMS

514-How to select industrial signals

Three major factors in signal selection are discussed in this bulletin: purpose of signal; areas to be covered; and noise levels to be overcome. Discusses general alarm, start and dismissal, coding or paging, and danger signals, for outdoor and indoor areas. Illustrations show recommendations for a typical plant. Condensed chart shows range for each signal type. Eight pages. FEDERAL SIGN & SIGNAL CORPORATION.

COMPRESSED AIR SUPPLY

515-Get cooler, drier air

How aftercoolers remove moisture from compressed air and gas is explained in Bulletin 130. Contains schematic flow diagrams showing how aftercoolers can cool and dry compressed air systems in any plant. Eight pages. NIAGARA BLOWER COMPANY.

516-Are you wasting air?

"A Better Air Power System," Folder 213A points out that power losses in compressed air lines are frequently as high as 30 to 50 percent. It describes just how to go about finding out if more air is being wasted than the repair and renovation of the distribution system would cost. Six pages. INGERSOLL-RAND CO.

CORROSION CONTROL

519-Meet the film-forming amines

"Film Forming Corrosion Inhibitors Also Aid Heat Transfer," four-page Technical Paper No. 129, contains references to protection afforded by filming amines and attendant reduction in maintenance costs secured through protection against corrosion. W. H. & L. D. BETZ.

DRAFTING METHODS, EQUIPMENT

521-Simplify your drafting practices

Sample drawings of engineered parts and assemblies illustrate the eleven rules (from the use of word descriptions for simple parts to making freehand drawings wherever possible) for simplifying drafting practices. These simplified methods have shown that it is possible to cut the total number of hours required to complete a given volume of work by 40 to 50 percent. Thirty-six pages. AMERICAN MACHINE AND FOUNDRY COMPANY.

ELECTRIC DISTRIBUTION

522-Current-limiting fuse charts

Hi-Cap fuses for protection of loads above 600 amperes are described in six-page Bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Explains use of these fuses in conjunction with Fusetron fuses. BUSSMANN MANUFACTURING CO.

523-How to choose circuit breakers

Essential information on selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections use charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Includes latest prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and eliminate errors. Sixty pages. I-T-E CIRCUIT BREAKER COMPANY.

525-Fuses for every purpose

Fuses for every purpose are illustrated and described in Folder 3. Also discusses Econ dual-element cartridge fuses for time-lag to protect against overloads and Economy delay renewable fuses and renewable links. ECONOMY FUSE & MFG. CO.

527-Dry transformer developments

"Latest Developments in Dry-Type Transformers," seven-page Catalog 153-A, presents the advantages of air-cooled units designed and constructed primarily for inside installations. SORGEL ELECTRIC CO.

ELECTRIC GENERATION

528-Considering diesel-electric?

Bulletin 31922 describes the many different uses to which diesel-electric generating plants can be put. Cutaway drawings and illustrations show installations as auxiliary, emergency, and portable equipment. Lists advantages of compactness, ease of operation, maintenance, reliability, and power output. Sixteen pages. CATERPILLAR TRACTOR CO.

ELECTRIC UTILIZATION

530-101 ways to heat with electricity

Industrial electric heating applications and methods are described in 32-page Booklet, "101 Ways to Apply Electric Heat." Illustrated case histories show experience-

. . . and this is Mr. Wilkins, our bird watcher!

tested ways to apply metal-sheathed Chromalox electric heating units in industrial jobs. EDWIN L. WIEGAND CO.

FUELS AND FIRING EQUIPMENT

531-Electric heating for heavy fuel oil

Typical electric oil heating systems are explained with the aid of diagrams in Bulletin 1644-B. Heater selection chart, wattage correction charts, and rating table are included with wiring diagrams and a description of stub heaters. Eight pages. PREFERRED UTILITIES MANUFACTURING CORPORATION.

533-Read about fuel oil additives

How to get complete protection from fuel tanks to burner tips is described in Bulletin 5012-A. Additives eliminate desludging operations, keep screens and burners clean, improve atomization and combustion, eliminate smoke and soot, and reduce rusting, pitting, and leaks. Includes recommended amounts of additive per 1000 gallons of fuel oil. Four pages. DEARBORN CHEMICAL COMPANY.

HEAT EXCHANGERS

534-Improve heat transfer

Engineers involved with design, maintenance, and repair of condensers and heat exchangers will benefit from information and data contained in Bulletin TB-412. This technical folder emphasizes the quality, dependability, and economy of electric-resistance-welded carbon steel tubing in all heat transfer applications. Includes chart outlining hydrostatic test pressures required for various tube sizes under ASTM A-214. Six pages. TUBULAR PRODUCTS DIVISION OF BABCOCK & WILCOX COMPANY.

INSTRUMENTS AND CONTROLS

536-All-purpose water flow meters

Principles of operation of nutating-piston-type meters are explained in Bulletin 36. It contains illustrations and data of typical installations, trap strainers, air release valves, high-pressure meters, and meter registers for the measurement of most fluids. Twenty pages. BUFFALO METER CO.

539-How to select liquid-level control

Bulletin-1 discusses the factors to be considered in selecting a liquid-level control. It includes controls in types and sizes for handling practically any liquid, at any pressure and any temperature. Eight pages. MAGNETROL, INC.

LIGHTING

541-Advanced outdoor lighting

Most advanced methods of lighting large outdoor areas evenly with minimum glare and low operating cost are discussed in Bulletin PL-242. Quality of light delivered, maintenance, safety, and appearance features are some of the salient Plexiglas features discussed. Sixteen pages. ROHM & HAAS COMPANY.

LUBRICATION

543-Do's and don'ts for bearings

A helpful list of "do's" and "don'ts" to prolong bearing life appears in Bulletin 506. Also included is information on the storage and handling of industrial lubricants. Four pages. NEW YORK AND NEW JERSEY LUBRICANT CO.

MAINTENANCE ITEMS

544-Repair methods handbook

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. SMOOTH-ON MFG. CO.

MATERIALS HANDLING (BULK)

548-Idlers improve conveyor belt handling

Design and application data on belt conveyors for bulk materials is contained in Bulletin 2-47. New design idlers consist of resilient neoprene or rubber discs molded to a flexible wire rope. Freely suspended idlers form a trough with each idler turning on its own axis. Idlers center the load, guide the belt, and provide a cushioned ride to keep belt wear and spillage to a minimum. New idlers provide for up to 50-percent increased spacing. Twelve pages. JOY MANUFACTURING COMPANY.

MECHANICAL POWER TRANSMISSION

552-Do you want the right roller chain?

Complete line of precision roller chain and sprockets is described thoroughly in Link-Belt Book 2457. It includes sections on stock drives, drive chain, conveyor chain, sprocket wheels, casings, chain tighteners, installation, maintenance, and lubrication. Well illustrated

BASIC BULLETINS

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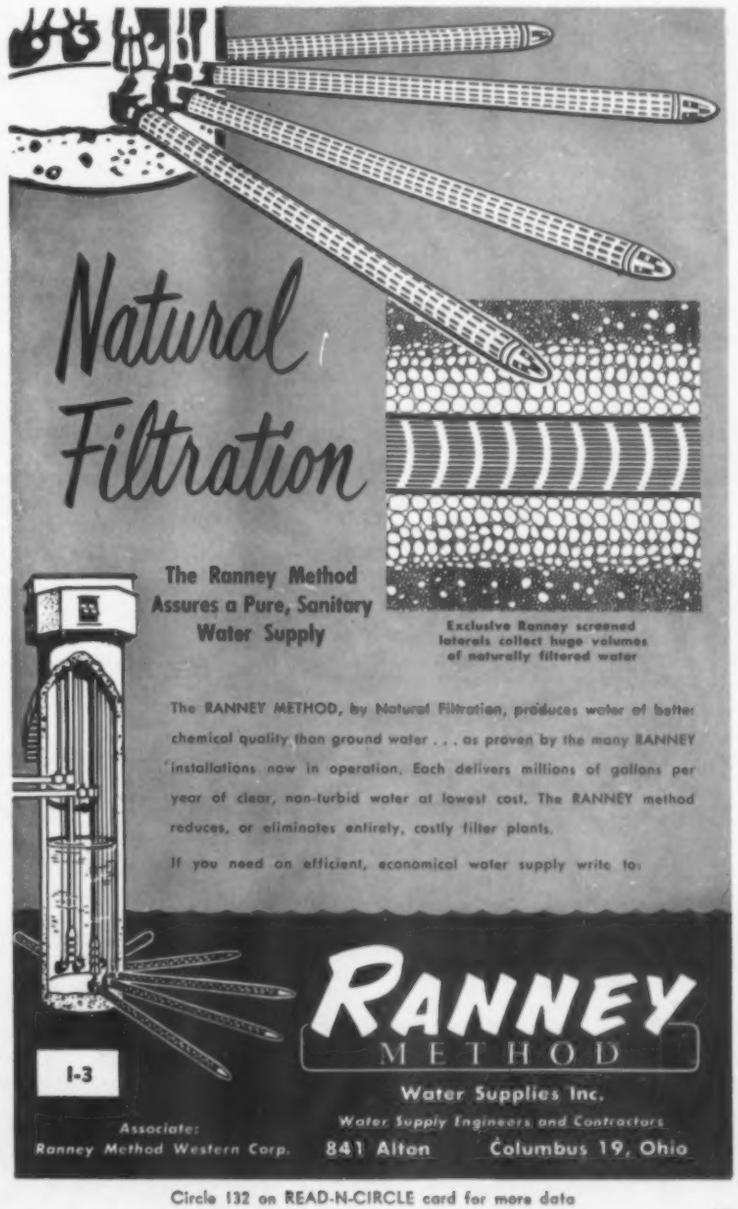
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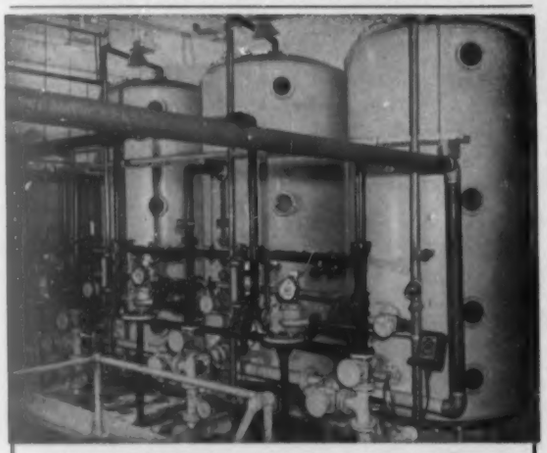

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basic bulletins

. . . starts on page 44

book gives all the information necessary to choose the right roller chain for any application. 148 pages. LINK-BELT COMPANY.

553-V-belt engineering handbook

Complete engineering data including formulas and typical examples for designing V-belt drives are contained in "Engineering Handbook for Multi-V Belts." Includes forty-one pages of pre-engineered drives for "A" through "E" belt sections. Tables give horsepower ratings for each type of belt and gives examples of the procedure, data required, and calculations to properly design V-belt and flat belt drives. A necessary manual for the library of all power services engineers. Seventy-eight pages. GOODALL RUBBER COMPANY.

PIPING, TUBING, AND HOSE

557-Wire-reinforced rubber pipe

Wire-reinforced rubber pipe that eliminates noise and vibration from waterlines is described in Catalog SZ-55. Gives operating characteristics and temperature ranges to 180 F for liquids, brine, and hot water lines, at operating pressures to 250 psi. Includes typical installations with dimensions for noise, vibration, and water hammer control. Four pages. T. R. FINN & COMPANY, INC.

PUMPING EQUIPMENT

558-Get more from steam pumps

Step-by-step illustrations, in Bulletin G-2280 P, give reader information on how to increase service life of all steam pumps. Offers 28 tips on proper installation and 54 tips on field-proven care techniques. Bulletin is specifically designed to aid operators and maintenance men in adding years of reliable service to steam pumps. Twenty-three pages. WORTHINGTON CORPORATION.

559-Piston packing data

How to select the proper pump packing for your equipment is described in Bulletin 5503. Engineering data is included on the full range of Pumcup compositions, textures, and types available for specified pressure, temperature, and corrosive conditions. Color-coding for easy identification of the proper composition for many fluids are listed, including gases, acids, and alkalies. Tables of standard sizes from 1- to 20-inch od are also included. Sixteen pages. DARLING VALVE & MANUFACTURING COMPANY.

REFRACTORIES AND INSULATION

560-Insulation, refractory handbook

Engineering data, formulas for calculating heat transmission, tables on heat losses from bare surfaces, and equivalent thicknesses of pipes are a part of the technical information contained in Bulletin IP-36A. Also includes descriptions of physical properties of the complete line of products. An excellent handbook containing information on all insulation and refractory problems. Fifty-two pages. JOHNS-MANVILLE.

TRAPS, STRAINERS, AND SEPARATORS

561-Steam trap manual

Real low-down on steam trap operation is contained in "Armstrong Steam Trap Book." Includes many illustrations of correct steam trap installations. Cutaway sections show steam trap operating principles. Lists steam traps for all sizes from ½ to 2 inch. Includes data on how to trap unit heaters, submerged steam coils and tubes, siphon drains, and low pressure heating systems. Includes illustrations of typical piping layouts incorporating steam traps. Forty-six pages. ARMSTRONG MACHINE WORKS.

TURBINES

564-Speed control fundamentals

"Fundamentals of Turbine Speed Control," 32-page Brochure H-21, is an educational piece intended to clarify the operation of common types of automatic speed control for steam turbines. Simplified diagrams illustrate actual control system operating principles. ELLIOTT CO.

VALVES AND REGULATORS

565-Data for full line of valves

Complete lines of valves for industrial use that meet a wide range of pressure, temperature and corrosion conditions are offered in Catalog No. 654. Specifications and engineering data are included. Sixty-six pages. REPUBLIC MANUFACTURING CO.

566-Valve comparison data

Replacing or reordering valves? This bulletin contains current data on all well-known valves manufactured today. Comparisons are given for each valve in relation to a corresponding OIC valve. Covers valves in pressure ranges from 125 to 2500 psi in all configurations —gate, angle, globe, and check, and in all materials—steel, bronze, and iron. Twenty-two pages. THE OHIO INJECTOR CO.

WASTE DISPOSAL

568-Waste problems solved

How this company has solved waste treatment problems for such industries as electro-plating, refinery, gas, and metal finishing is treated in detail in six-page Booklet 70-B. INFILCO, INC.

HOW TO GET COPIES

To get a free copy of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on pages 49 or 50.

WATER SUPPLY AND TREATMENT

570-Demineralizing handbook

"Handbook on Demineralizing," Bulletin 5800-B, compares various methods of water treatment including demineralizers and evaporators. It goes into characteristics of various types of available cation and anion exchange materials and gives information on operating costs. Forty pages. COCHRANE CORP.

good books

. . . for industry power

Readers wanting to obtain copies of these books may order through INDUSTRY POWER. Send check covering cost and we will forward your order to the publisher.

Basic Lubrication Practice, by Allen F. Brewer; Reinhold Publishing Corporation; 300 pages; $6.75.

"Basic Lubrication Practice" gives practical, on-the-job working information for selection and use of lubricants for industrial and power plant machinery. Text includes 24 chapters covering all phases of lubrication. Particular emphasis is placed on importance of proper lubrication in machinery maintenance, and on the relation of machine design to operating conditions.

Of particular interest is a series of illustrations showing gear damage due to causes such as abrasive action, overload, fatigue, corrosive materials in lubricants, and extreme high-temperature operation. Also contains brief, nontechnical description of basic ASTM physical tests for petroleum lubricants.

Typography is average, but illustrations leave much to be desired. Data charts and curves are too small to be of practical value. Book is written to appeal both to the student of practical lubrication and to the machinery operator who wants to know more about lubrication.

How long am I gonna be on this insulation sprayer?

Why a Power Show Contest?

Read why INDUSTRY POWER is running a Power Show Contest . . . See page 11. Then read all about the Contest . . . See page 3.

Electricity—Direct and Alternating Current, by Charles S. Siskind; McGraw-Hill Book Company; 540 pages; $5.75.

Text of this book discusses the general elementary principles of direct- and alternating-current electricity. It illustrates how these principles apply to construction and operating characteristics of the more common circuits, devices, and machines. Contains a series of simple experiments to demonstrate practical applications and to verify the principles discussed.

Ohm's law and Kirchhoff's laws are explained with simple formulas. Text is written at the student level, with mathematics restricted to simple algebra.

Sections on single-phase and polyphase machines, their principles of operation, characteristics, applications, and control are enlarged to include most present-day types. This fundamental textbook is directed toward giving basic understanding of electricity.

Fifth Symposium (International) on Combustion, by The Combustion Institute; Reinhold Publishing Corporation; 828 pages; $15.00.

This volume presents all 101 papers presented at the Fifth International Combustion Symposium held at University of Pittsburgh in 1954. Contains the work of 182 contributors and makes available a large and important body of new knowledge on combustion problems involved in the efficient operation of all engine types. Papers deal with important subjects such as kinetics of combustion reactions, combustion of fuel droplets, combustion of solids, propellant burning, flame spectra and dissociation energies, and special processes in engines. Text is written primarily for scientists and engineers. Thorough knowledge of calculus is necessary to obtain maximum benefit from this book.

Typography and illustrations are average. Subject matter is more valuable to engineers in research fields rather than to operating engineers.

Design Manual for Roller and Silent Chain Drives, by Association of Roller and Silent Chain Manufacturers (Jackson and Moreland); 98 pages; $3.50.

This manual offers a comprehensive presentation of the theoretical and practical aspects of roller- and silent-chain power drives. Contents and arrangement follow the advice of experienced engineers, who are passing on the benefit of years of design experience.

Separate chapters compare types of mechanical power drives and list the advantages of each. Formulas are included to demonstrate theory and design principles. Excellent illustrations show many in-use installations to further clarify written material. Charts are included to illustrate selection of chain drives for any application.

Clear, detailed descriptions of electronic tubes and circuits

This valuable manual supplies the man who uses electronics equipment in plants with a complete, non-technical description of electronics circuits and equipment. It provides this information without demanding a special technical background of the reader.

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Tachometer Headquarters

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I'll have to hang up now baby—a big wheel just dropped into my office.

names make news

. . . personalities from industry power

General Electric Company appoints **Dr. Robert O. Fehr,** manager, Mechanical Engineering Laboratory. Dr. Fehr, internationally recognized authority on acoustics and vibration, joined General Electric in 1939. Following World War II, he served on the Noise Control Subpanel, U.S. Department of Defense Research and Development Board. He is a member of a committee of the National Research Council, a fellow of the Acoustical Society of America, and a member of AIEE.

Hite

Niessen

American Hoist & Derrick Company promotes eight men. **J. J. Hite,** formerly chief engineer, becomes director of engineering. He is known for his work in developing the original diesel-electric locomotive crane. **William Niessen,** newly appointed chief structural engineer, joined the company in 1940 as an estimating and designing engineer. New chief mechanical engineer is **Kenneth Potter. H. T. Bratt** becomes assistant chief engineer in charge of revolving cranes, derricks, and hoists. **R. G. Lynn** is new assistant chief engineer in charge of all electrical applications. **A. W. Brown,** former construction engineer, is chosen assistant chief engineer in charge of excavators and truck cranes. An employee of American Hoist since 1928, **Charles Milnar** is appointed mechanical engineer, locomotive cranes. **R. D. Adkins** is now mechanical engineer of the newly created Crosby-Laughlin Division.

Ebasco Services, Inc. announces appointment of **Charles C. Bonin** engineering manager, **H. K. Fairbanks** chief concrete-hydraulic engineer, and **G. F. Latham** chief architectural-structural engineer.

AIEE names nine men to rank of Fellow for their contributions to industry, public utilities, and education. Those honored are: **J. E. Barfield,** vice president, St. Joseph Light and Power Company; **John Bruce Coleman,** administrative engineer, Radio Corporation of America; **George J. Fielder,** principal engineer, Sverdrup and Parcel, Inc.; **John H. Kuhlmann,** professor of electrical engineering, University of Minnesota; **Olan Richardson,** president, Southern States Equipment Corporation; **S. L. Scheffer,** project director, Burns and Roe, Inc.; **L. C. Whitman,** development engineer, General Electric Company; **J. E. Gaghan,** chief engineer, Ansco Division, General Aniline and Film Corporation; and **Ivar Herlitz,** electrical engineer for Svesnka Elertriska Artiebolaget in Sweden.

ASME nominates **William F. Ryan** president. Ryan is vice president, director, and senior consulting engineer of Stone & Webster Engineering Corporation, Boston. Ryan has been active in ASME since 1917. Nominee for technical director is **Eugene W. Jacobson,** chief design engineer, Gulf Research & Development Company. **V. Weaver Smith,** vice president of the Lummus Company, is nominee for administrative director. Officers will be installed in November.

Alco Products, Inc. announces promotions. **R. Tom Sawyer,** research manager for Alco since 1953, is appointed consultant on engineering and development problems. Sawyer will also become a staff consultant of the Experimental Towing Tank at Stevens Institute of Technology, where he will work on Army development projects. **Chauncey A. Mitchell** is named superintendent of manufacturing services. **Charles R. Funk,** formerly chief metallurgist for Alco, is now manager of metallurgy and engineering.

Galliger

Brainerd

The New York Air Brake Company appoints **Karl W. Galliger** director of engineering. Galliger will supervise company research and engineering programs of all the engineering departments within the company.

Metalcraft Products Company, Inc., retains **Dr. Arthur A. Brainerd** as illumination consultant. Dr. Brainerd recently retired from Philadelphia Electric Company, where he was in charge of technical lighting program. Dr. Brainerd is one of the nation's foremost authorities on illumination. From 1948 to 1955 Dr. Brainerd was president of the U.S. National Committee of the Commission Internationale de l'Eclairage, and is now vice president of that organization.

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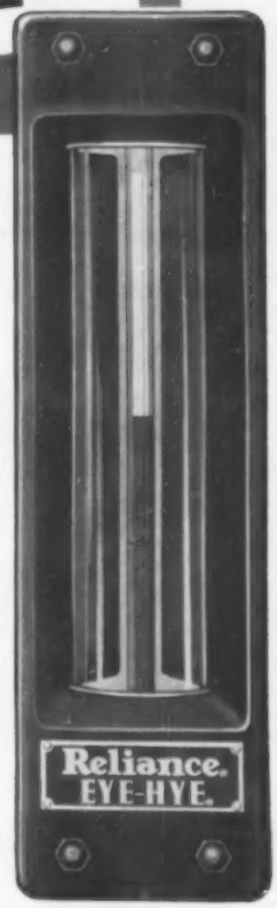
Newly Styled—
Wide Vision, Simplified Face
EYE-HYE®



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Accurate "liquid column" reading visible from large area because of brilliantly illuminated green liquid and wide angle face plate.

EYE-HYE is the original trouble-free manometric gage for dependable remote water level supervision. There's nothing new about its *operation*, but the new face plate and new illumination (fluorescent) make it easier to read all over the control room.

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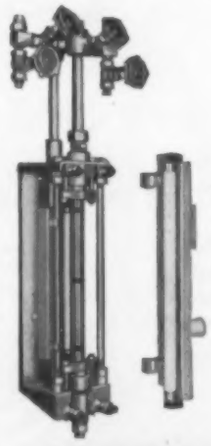

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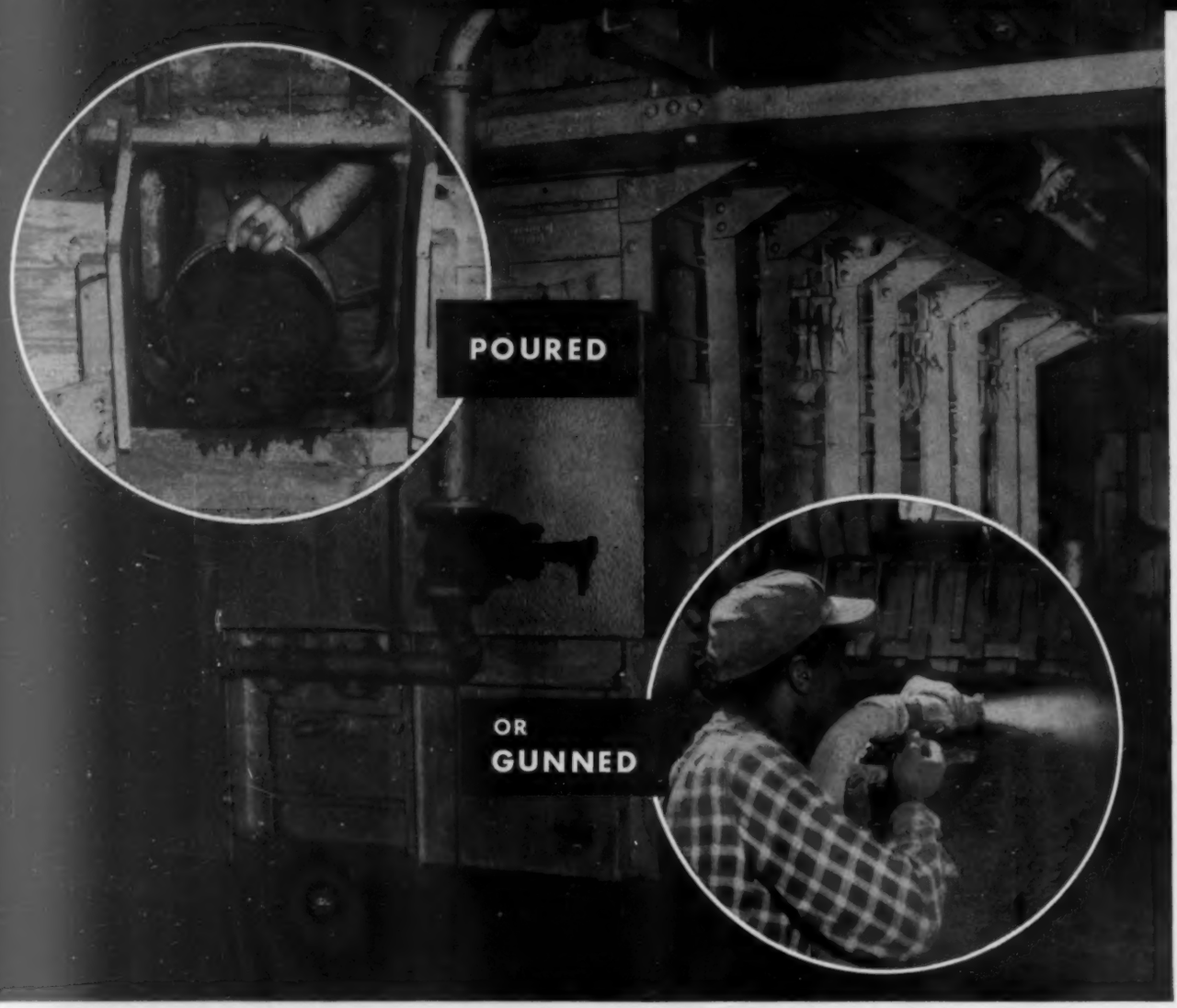

B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

Send for Bulletin R-36 which gives data on B&W's wide line of specialized boiler refractories.

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space-saving fuel oil pumping and heating units are available in both medium- and high-pressure types. Send for bulletin.

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Solid steel collars
Read page 28 and circle number 119
STANDARD PRESSED STEEL CO., HALLOWELL

POWER TRANSMISSION DIVISION. Solid steel collars that stay put are stocked in 42 sizes. Held on shaft by Unbrako Set Screws. Bulletin 868 describes complete stocks and uses.

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Read page 36 and circle number 121
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Read page 58 and circle number 126
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How to cut refractory maintenance
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Don't have your pocket picked
Read page 2 and circle number 136
DEARBORN CHEMICAL CO. Stop pipe pitting which means out-of-pocket expenses by investigating Filmeen. Send coupon for more information on this water treatment service.

Scale still blows 'em up!

WHY DO BOILERS FAIL? Answer still lies with scale formation, according to *The Locomotive*, of Hartford Steam Boiler Inspection and Insurance Company.

In a detailed study just reported, lack of proper boiler water treatment was found to be foremost among direct causes of accidents attributable to scale. Some of the more-or-less indirect causes which the study revealed are:

- Inoperation of feedwater regulators caused by scale in the pipe connection to those devices, resulting in damage from low water.
- Wasting more than the normal amount of condensate without increasing the feedwater treatment to compensate for the additional raw make-up water.
- Scale and mud accumulations in low-water fuel cut-offs and their pipe connections, preventing those protective devices from functioning when a low water condition occurs.
- Indiscriminately increasing the amount of boiler water treatment after noting that the amount of adhering scale has appreciably increased.
- Change of feedwater treatment where the previous treatment was found to be inadequate. New chemicals, often more effective, cause rapidly loosening of old adhering scale with damaging effects.
- Plugging of feedwater piping, usually caused by reaction of chemicals to precipitate scale within the piping rather than in the boiler. This often occurs when the treatment is introduced into the feedwater.
- Abnormally large amounts of untreated raw water pumped into boilers from the raw water supply. This is connected to the feedwater piping between the treating equipment and the boiler for emergency use only.
- Failure, on fire-tube horizontal tubular boilers, of blow-off piping through which feedwater has flowed and caused scale to become baked on the internal surfaces. (In some cases, rapid draining of the boiler following a blow-off piping failure has also caused considerable additional damage to the boiler by overheating.) ♦ ♦

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FIG. 21 LIP-MOLD
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Safe motor control

. . . starts on page 19

breaker or set of fuses. This limits let-through energy, while short-circuit current flows, to a small enough value to prevent damage to the starter. An interrupting rating is given the combination, expressed as the total available short-circuit current at the controller installation. The manufacturer assumes responsibility for design and component coordination. User has the assurance that combination starter, when applied within its interrupting rating, gives protection to the motor branch-circuit.

what is a combination starter?

A combination starter consists of a molded-case breaker and a full-voltage magnetic starter. Circuit breaker has combination thermal-magnetic trips. On normal overloads, the tripping characteristic is inverse-time, permitting a squirrel-cage motor to start. At high fault currents tripping is instantaneous, total interrupting time varying between one and three half-cycles on a 60-cycle basis. Up to NEMA size 4 (150 amperes), combination starters are offered with 15,000-ampere interrupting ratings. Larger starters are available with a 25,000-ampere interrupting rating. Circuit breaker serves as a disconnecting means to isolate starter from line.

Combination starters are also available with motor-circuit switches, rated in horsepower. They are capable of breaking stalled-rotor current, as disconnecting devices, and as fuses for short-circuit protection. Many starters are in service that use standard NEC fuses. Such fuses are approved by Underwriters' Laboratories, Inc. under accepted fuse standards. They do not have an ac interrupting rating, and their manufacturers do not guarantee definite interrupting ability. Operating experience indicates that combination starters with NEC fuses give adequate protection on systems with an available short circuit current of 25,000 ampere. Several fuses are now available that have a stated high-interrupting rating. Combination starters may be used with such fuses on systems having an available short-circuit current of 50,000 amperes.

combine starters in control centers

When a plant contains many motors, it is economically advantageous to combine motor starters into a motor control center. This is an assembly of combination starters in a common structure, each containing vertical compartments housing the starters. Center contains a horizontal main bus and vertical risers to which the starters are connected. Orderly arrangement, likewise, is conducive to good housekeeping and maintenance. Manufacturer supplies bus work properly braced to withstand short-circuit let-through energy in conformity with the control center interrupting rating. This rating is the available short-circuit current the system produces at the control center installations. Control centers may be obtained with circuit breakers or with fuses. Standard ratings are 15,000, 25,000, and 50,000 amperes. Available short-circuit current is largely governed by rating of the stepdown transformer.

Largest transformer to which a control center of a given interrupting rating can be connected, unless short-circuit current is artificially reduced by feeder-circuit impedance or current-limiting reactors, is as follows:

Interrupting Rating	Transformer Kva at	
Amperes	240 Volts	480 Volts
15,000	200	400
25,000	300	750
50,000	750	1500

high-voltage controller ratings

High-voltage high-interrupting capacity controllers are rated in available, symmetrical, short circuit kva. In NEMA Standards, they are designated as Class E controllers. Two types are offered. Class E1 controllers include contactors that have an inherent high-interrupting ability. Main controller contacts perform the dual function of interrupting motor load and overload currents, as well as interrupting fault currents. Contactors may be airbreak type, or they may be oil-immersed. Contactors and auxiliary components such as disconnects, control and current transformers, thermal overload and instantaneous trip relay, and undervoltage relay, are housed in an enclosure to give protection to the operator against accidental contact with live parts. Busses and other power components are designed and braced so that they are not damaged by the let-through energy and the resultant thermal and magnetic stresses. Standard interrupting ratings are 25,000 and 50,000 kva.

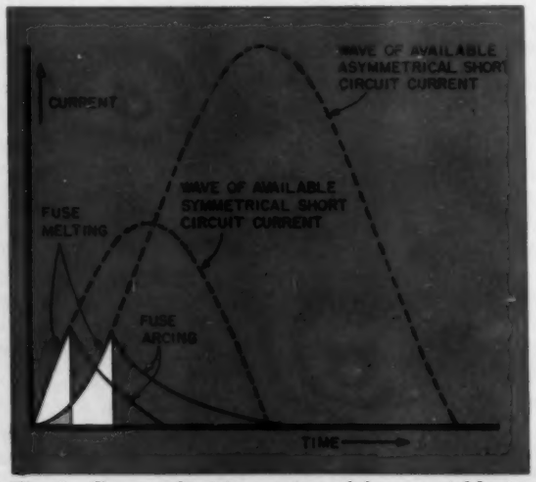

Fig. 3—Current-limiting action of fuses quickly interrupts faults, relieving controllers of surge duty.

Class E2 controllers contain contactors with an interrupting ability of 10 times rated motor current. Contactors are utilized for making and breaking motor-load and overload currents. Fuses are included for interrupting short-circuit currents. Most Class E2 controllers offered today use fast-acting current-limiting fuses (Fig. 3). Fuse, containing silver fusible wires embedded in quartz sand, melts so that current is prevented from rising to its initial peak value during the first half-cycle after short-circuit incidence. Current tapers off during subsequent arcing period. Actual arc extinction takes place within approximately one half-cycle. Class E2 controllers are rated to be connected to power systems producing available symmetrical short circuit kva of 150,000 at 2200 to 2400 volts or 250,000 at 4000 to 4800 volts.

Typical Class E2 controller will permit safe full-voltage synchronous motor starting. Top compartment houses a gang-operated disconnect switch and current-limiting fuses. Center compartment contains a swinging panel mounting low-voltage components for field application and auxiliary control. Bottom compartment houses the high-voltage air break contactor. Compartments are segregated by fixed steel barriers so that maintenance men can safely work on the low-voltage devices without accidentally contacting live parts in the high-voltage compartments. Mechanical interference-type interlock prevents opening of the high-voltage compartment doors unless contactor is dropped out and power is removed from the motor branch circuit. Operating handle for the disconnect switch actuates the disconnect compartment door latch. Access to fuses for renewal can be gained only with the controller isolated from the line.

power growth means more consideration

Power system growth is expected to continue in the future, increasing potential short-circuit danger in motor branch circuits. Controllers should be selected carefully, based on adequate interrupting performance. Standard general-purpose low-voltage controllers can be protected by separate circuit breakers or fuses. Combination controller use gives assurance that controller and short-circuit protective means are properly coordinated to obtain safe interrupting within the stated rating.

Practice of using controller with 10 times motor current interrupting ability backed up by an 8-cycle breaker is discouraged as far as high-voltage branch circuits are concerned. Serious acidents prove that such a combination cannot be relied upon to obtain safe and reliable interruption of short circuits. Only Class E controllers, designed for high-interrupting capacity, and having stated interrupting rating, are considered for controlling high-voltage motors. ♦ ♦

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. . . from industry power

Single copies of following reprints are available free. Quantity orders for individual reprints quoted on request. Address all correspondence, on company letterhead, please, to Reader Service Department INDUSTRY POWER, Commercial Bank Building, St. Joseph, Michigan.

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But—whether you pay nothing, or such a "token fee," you — the reader — do not *really* pay for the magazine's service.

No—advertisers pay the bills . . . and so, logically, advertisers *demand* the best possible coverage of the important, key men of the field. That means folks like you, who exercise buying power.

INDUSTRY POWER "hand-picks" its readers—for best, effective circulation . . . and sends the magazine to these key folks, without charge.

You see, you simply can't get maximum coverage of important folks by trying to force them to buy subscriptions. Such men, limited in numbers, are scattered all over the U.S.A.; travel and/or direct mail, cost money; a large share "forget to renew" each year; and, no matter how much time, money and pressure you put on them, there are always some important men who will never buy.

You don't "pay"—INDUSTRY POWER gets better circulation. So, as you can see, a subscription price is at best but a "token payment." You don't really pay for any magazine with $3.00 or $5.00.

But, INDUSTRY POWER gets the best, most effective circulation coverage by "hand-picking" the right readers. This gives values to advertisers which they can't possibly get in any other way.

That's why . . . INDUSTRY POWER hand-picks only qualified readers . . . Men Who Manage Power Services . . . presidents, partners, plant managers, chief engineers, plant engineers, consulting engineers, etc. in manufacturing plants, utilities, engineering services, and institutions. Then the editors make the magazine so interesting, so valuable, these folks want to read it.*

That's why INDUSTRY POWER spends many thousands of dollars on each issue—to give you this service without charge . . . as *you* are an important reader in the power services field.

No, you can't "pay for" any good business magazine with $3.00 or $5.00. Whether you receive a "paid magazine" or a "non-paid magazine" you are still enjoying a valuable service—whose cost is far above any price you paid for a subscription.

**Every issue proves this qualified readership . . . by unequalled response from these key readers. May we show you the evidence?*

. . . . . .

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coming events

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Sept. 17-21	Instrument Society of America 1956 Conference and Exhibit	Coliseum New York City
Sept. 17-21	Illuminating Engineering Society National Technical Conference	Hotel Statler Boston
Sept. 25-27	Third Annual Conference Atomic Industrial Forum	Morrison Hotel Chicago
Oct. 1-5	AIEE Fall General Meeting	Morrison Hotel Chicago
Oct. 8-10	ASME Lubrication Conference	Atlantic City New Jersey
Oct. 11-12	Armour Research Foundation National Noise Abatement Symposium	Sherman Hotel Chicago
Oct. 22-24	Seventeenth Annual Water Conference	Hotel Wm. Penn Pittsburgh
Oct. 24-25	ASME Fuels Conference	Washington, D.C.
Nov. 25-30	ASME Annual Meeting	Hotel Statler New York City
Nov. 25-30	ASME Power Show	Coliseum New York City

next month in
INDUSTRY POWER . . .

how Jersey Central P & L cuts costs with cable trough

Cable trough is saving installation time and money for Jersey Central Power & Light in its most recent expansion of Edwin H. Werner Station. More current-carrying ability is packed into each run of power conductors. Greater utilization of space is achieved for control cables.

Perhaps you can pick up some tips on more efficient support of power and control conductors in your plant by reading how Jersey Central uses cable trough. And, you will see another high-visibility "Cinemascope" photograph with this story . . . the kind of photograph in which you can see everything. Watch for it, coming in the

September issue of INDUSTRY POWER

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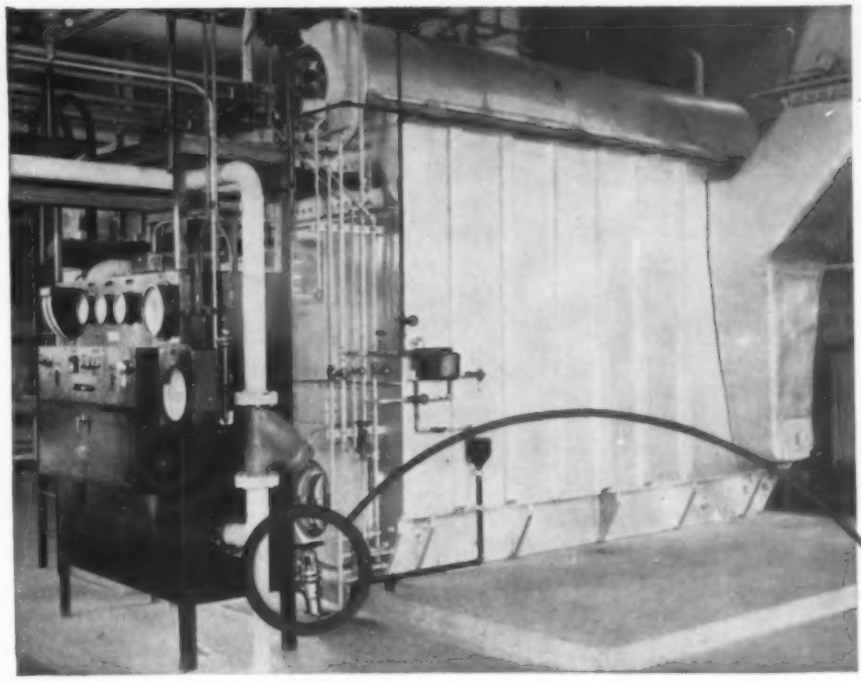

COMBUSTION ENGINEERING ADOPTS YARWAY SEATLESS BLOW-OFF VALVES FOR PACKAGE BOILERS

Combustion Engineering, Inc. on this package boiler installation at the Orangeburg Pipe Plant in California, again includes Yarway Seatless Blow-Off Valves as part of the "package."

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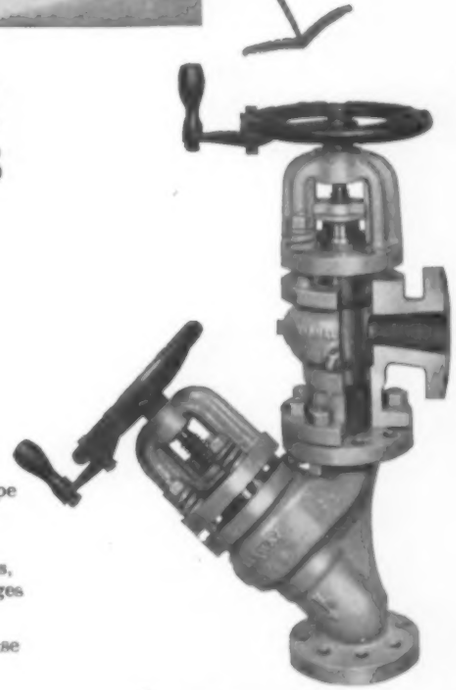

Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY BLOW-OFF VALVES

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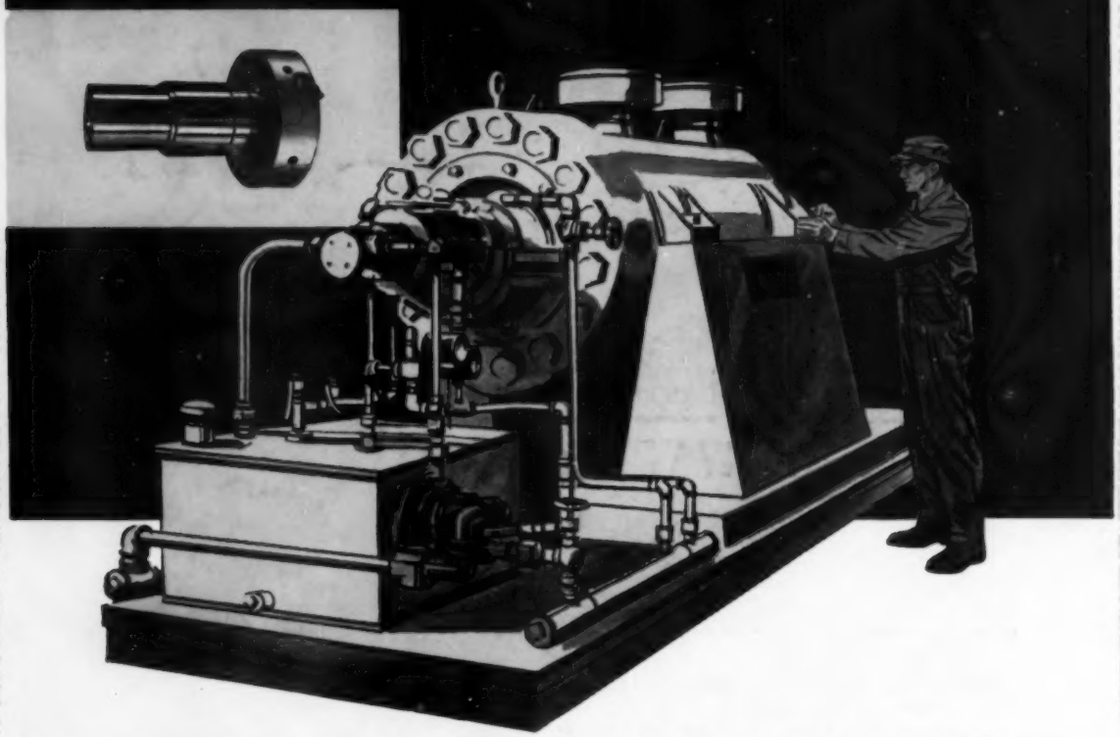

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